

Day :  
 Wednesday  
 Date:  
 7/23/2003  
 Time:  
 20:05:47

## PALM INTRANET

### Inventor Name Search Result

Your Search was:

Last Name = FISCHER

First Name = ERNESTO

Application#	Patent#	Status	Date Filed	Title	Inventor Name
<a href="#"><u>60458005</u></a>	Not Issued	020	03/27/2003	INTEGRATED PROCESSING OF NATURAL GAS INTO LIQUID PRODUCTS	FISCHER-CALDERON, ERNESTO
<a href="#"><u>10051425</u></a>	Not Issued	030	01/18/2002	INTEGRATED PROCESSING OF NATURAL GAS INTO LIQUID PRODUCTS	FISCHER-CALDERON, ERNESTO
<a href="#"><u>10050922</u></a>	6564578	150	01/18/2002	SELF-REFRIGERATED LNG PROCESS	FISCHER-CALDERON, ERNESTO

Inventor Search Completed: No Records to Display.

Search Another:

Last Name

First Name

Inventor

To go back use Back button on your browser toolbar.

Back to [PALM](#) | [ASSIGNMENT](#) | [OASIS](#) | Home page

Day :  
 Wednesday  
 Date:  
 7/23/2003  
 Time:  
 20:07:49

# PALM INTRANET

## Inventor Name Search Result

Your Search was:

Last Name = BRISCOE

First Name = MICHAEL

Application#	Patent#	Status	Date Filed	Title	Inventor Name
<a href="#"><u>60458213</u></a>	Not Issued	020	03/27/2003	FUEL BLENDS COMPRISING LNG AND DIMETHYL ETHER AND METHODS FOR PREPARATION OF SAME	BRISCOE, MICHAEL D.
<a href="#"><u>60458005</u></a>	Not Issued	020	03/27/2003	INTEGRATED PROCESSING OF NATURAL GAS INTO LIQUID PRODUCTS	BRISCOE, MICHAEL D.
<a href="#"><u>60137642</u></a>	Not Issued	159	06/04/1999	ALTERNATING CONTRAST FILM/STICKER	BRISCOE, MICHAEL A
<a href="#"><u>29037544</u></a>	Not Issued	161	03/31/1995	BRUSH ATTACHMENT FOR A SAUCE BOTTLE	BRISCOE, MICHAEL A.
<a href="#"><u>10430734</u></a>	Not Issued	020	05/06/2003	LOADED TRANSDUCER FOR DOWNHOLE DRILLING QOMPONENTS	BRISCOE, MICHAEL
<a href="#"><u>10427522</u></a>	Not Issued	019	04/30/2003	DATA TRANSMISSION SYSTEM FOR A DOWNHOLE COMPONENT	BRISCOE, MICHAEL
<a href="#"><u>10201339</u></a>	Not Issued	030	07/23/2002	HYDROGEN TO STEAM REFORMING OF NATURAL GAS TO SYNTHESIS GAS	BRISCOE, MICHAEL D.
<a href="#"><u>10051425</u></a>	Not Issued	030	01/18/2002	INTEGRATED PROCESSING OF NATURAL GAS INTO LIQUID PRODUCTS	BRISCOE, MICHAEL D.
<a href="#"><u>09408731</u></a>	Not Issued	161	09/29/1999	AUTOTHERMAL REACTOR AND A METHOD FOR CONVERTING A LIGHT HYDROCARBON STREAM INTO A SYNTHESIS GAS	BRISCOE, MICHAEL D.
<a href="#"><u>09405431</u></a>	<a href="#"><u>6156234</u></a>	150	09/23/1999	PROCESS FOR SUPPLYING A GASEOUS MIXTURE TO	BRISCOE, MICHAEL D.

				AN AUTOTHERMAL REACTOR	
<u>09401604</u>	Not Issued	161	09/22/1999	HIGH PRESSURE AUTOTHERMAL REACTOR AND A METHOD FOR PRODUCING SYNTHESIS GAS	BRISCOE , MICHAEL D.
<u>09401420</u>	<u>6239184</u>	150	09/22/1999	EXTENDED CATALYST LIFE FISCHER-TROPSCH PROCESS	BRISCOE, MICHAEL D.
<u>09397166</u>	<u>6344491</u>	150	09/16/1999	METHOD FOR OPERATING A FISCHER-TROPSCH PROCESS USING A HIGH PRESSURE AUTOTHERMAL REACTOR AS THE PRESSURE SOURCE FOR THE PROCESS	BRISCOE , MICHAEL D.
<u>07321322</u>	<u>D321237</u>	150	03/10/1989	HOLLOW FISHING LURE	BRISCOE , MICHAEL A.

Inventor Search Completed: No Records to Display.

**Search Another:**  
**Inventor**

<b>Last Name</b>	<b>First Name</b>
<input type="text" value="Briscoe"/>	<input type="text" value="Michael"/>
<input type="button" value="Search"/>	

To go back use Back button on your browser toolbar.

Back to [PALM](#) | [ASSIGNMENT](#) | [OASIS](#) | Home page

# WEST Search History

DATE: Wednesday, July 23, 2003

<u>Set Name</u>	<u>Query</u>	<u>Hit Count</u>	<u>Set Name</u>
side by side			result set
<i>DB=USPT,PGPB,JPAB,EPAB,DWPI; THES=ASSIGNEE; PLUR=YES; OP=ADJ</i>			
L18	L17 and isentropic\$4	23	L18
L17	L16 or l12	23	L17
L16	L15 and (methanol or dimethyl ether or Fischer tropsch)	8	L16
L15	L14 and gas near1 liquid	48	L15
L14	L13 and expan\$4	89	L14
L13	l9 and liqu\$7 near1 natural gas	89	L13
L12	L11 and gas near2 liquid	15	L12
L11	L10 and expan\$4	19	L11
L10	L9 and liquif\$5 natural gas	19	L10
L9	isentropic\$4	1455	L9
L8	L5 and liquif\$5 near2 neatural gas	0	L8
L7	L5 and liquif\$5 neatural gas	0	L7
L6	L5 and liquified neatural gas	0	L6
L5	L4 and natural gas	93	L5
L4	isentopic\$4 or isenthalpic\$4	405	L4
L3	L1 and expan\$4	1	L3
<i>DB=USPT,PGPB; THES=ASSIGNEE; PLUR=YES; OP=ADJ</i>			
L2	L1 and expan\$4	1	L2
L1	4445917.pn.	1	L1

END OF SEARCH HISTORY

Search Results - Record(s) 1 through 23 of 23 returned.

1. Document ID: US 20030101728 A1

L18: Entry 1 of 23

File: PGPB

Jun 5, 2003

PGPB-DOCUMENT-NUMBER: 20030101728

PGPB-FILING-TYPE: new

DOCUMENT-IDENTIFIER: US 20030101728 A1

TITLE: Cold heat reused air liquefaction/ vaporization and storage gas turbine electric power system

PUBLICATION-DATE: June 5, 2003

INVENTOR-INFORMATION:

NAME	CITY	STATE	COUNTRY	RULE-47
Wakana, Harumi	Hitachi-shi		JP	
Chino, Koichi	Hitachi-shi		JP	
Yokomizo, Osamu	Naka-gun		JP	

APPL-NO: 10/ 183358 [PALM]

DATE FILED: June 28, 2002

RELATED-US-APPL-DATA:

Application 10/183358 is a continuation-in-part-of US application 09/765338, filed January 22, 2001, ABANDONED

FOREIGN-APPL-PRIORITY-DATA:

COUNTRY	APPL-NO	DOC-ID	APPL-DATE
JP	8-349301	1997JP-8-349301	December 27, 1997
JP	8-343061	1997JP-8-343061	December 24, 1997

INT-CL: [07] E02 C 7/143

US-CL-PUBLISHED: 60/727; 60/728

US-CL-CURRENT: 60/727; 60/728

REPRESENTATIVE-FIGURES: 1

ABSTRACT:

An energy storage gas-turbine electric power generating system includes a liquid air storage tank for storing liquid air, a vaporizing facility for vaporizing the liquid air stored in the liquid air storage tank, a combustor for generating a combusted gas by combusting the air vaporized by the vaporizing facility and a fuel, a gas turbine driven by the combusted gas generated in the combustor, and a gas-turbine generator connected to the gas turbine for generating electric power. The system further includes a pressurizing unit for pressurizing the liquid air stored in the liquid air storage tank up to a pressure higher than a pressure of air supplied to the combustor to supply the liquid air to the vaporizing facility, an expansion turbine driven by expanding the air vaporized by the vaporizing facility and an expansion-turbine generator connected to the expansion turbine for generating electric power.

[0001] This is a continuation-in-part (CIP) application of U.S. Ser. No. 09/765,338 filed Jan. 22, 2001, now pending, the entire disclosure of which is hereby incorporated by reference.

Full	Title	Citation	Front	Review	Classification	Date	Reference	Sequences	Attachments	Claims	KWIC
Draw Desc   Image											

2. Document ID: US 20020151604 A1

L18: Entry 2 of 23

File: PGPB

Oct 17, 2002

PGPUB-DOCUMENT-NUMBER: 20020151604

PGPUB-FILING-TYPE: new

DOCUMENT-IDENTIFIER: US 20020151604 A1

TITLE: Hydrogen and elemental carbon production from natural gas and other hydrocarbons

PUBLICATION-DATE: October 17, 2002

INVENTOR-INFORMATION:

NAME	CITY	STATE	COUNTRY	RULE-47
Detering, Brent A.	Idaho Falls	ID	US	
Kong, Peter C.	Idaho Falls	ID	US	

APPL-NO: 10/ 109427 [PALM]

DATE FILED: March 27, 2002

RELATED-US-APPL-DATA:

Application 10/109427 is a division-of US application 09/732451, filed December 6, 2000, US Patent No. 6395197

Application is a non-provisional-of-provisional application 60/172976, filed December 21, 1999,

INT-CL: [07] C07 C 27/06, B01 J 19/12

US-CL-PUBLISHED: 518/703; 422/186.29

US-CL-CURRENT: 518/703; 422/186.29

REPRESENTATIVE-FIGURES: 1

ABSTRACT:

Diatomeric hydrogen and unsaturated hydrocarbons are produced as reactor gases in a fast quench reactor. During the fast quench, the unsaturated hydrocarbons are further decomposed by reheating the reactor gases. More diatomic hydrogen is produced, along with elemental carbon. Other gas may be added at different stages in the process to form a desired end product and prevent back reactions. The product is a substantially clean-burning hydrogen fuel that leaves no greenhouse gas emissions, and elemental carbon that may be used in powder form as a commodity for several processes.

RELATED APPLICATION

[0001] This application is a divisional of pending application Ser. No. 09/732,451, filed Dec. 6, 2000, which claims priority from United States provisional application Serial No. 60/172,976, filed Dec. 21, 1999.

Welcome to STN International! Enter x:x

LOGINID: ssspta1202jxp

PASSWORD:

TERMINAL (ENTER 1, 2, 3, OR ?):2

NEWS 1 Web Page URLs for STN Seminar Schedule - N. America  
NEWS 2 "Ask CAS" for self-help around the clock  
NEWS 3 Feb 24 PCTGEN now available on STN  
NEWS 4 Feb 24 TEMA now available on STN  
NEWS 5 Feb 26 NTIS now allows simultaneous left and right truncation  
NEWS 6 Feb 26 PCTFULL now contains images  
NEWS 7 Mar 04 SDI PACKAGE for monthly delivery of multifile SDI results  
NEWS 8 Mar 24 PATDPAFULL now available on STN  
NEWS 9 Mar 24 Additional information for trade-named substances without structures available in REGISTRY  
NEWS 10 Apr 11 Display formats in DGENE enhanced  
NEWS 11 Apr 14 MEDLINE Reload  
NEWS 12 Apr 17 Polymer searching in REGISTRY enhanced  
NEWS 13 Jun 13 Indexing from 1947 to 1956 added to records in CA/CAPLUS  
NEWS 14 Apr 21 New current-awareness alert (SDI) frequency in WPIDS/WPINDEX/WPIX  
NEWS 15 Apr 28 RDISCLOSURE now available on STN  
NEWS 16 May 05 Pharmacokinetic information and systematic chemical names added to PHAR  
NEWS 17 May 15 MEDLINE file segment of TOXCENTER reloaded  
NEWS 18 May 15 Supporter information for ENCOMPPAT and ENCOMPLIT updated  
NEWS 19 May 19 Simultaneous left and right truncation added to WSCA  
NEWS 20 May 19 RAPRA enhanced with new search field, simultaneous left and right truncation  
NEWS 21 Jun 06 Simultaneous left and right truncation added to CBNB  
NEWS 22 Jun 06 PASCAL enhanced with additional data  
NEWS 23 Jun 20 2003 edition of the FSTA Thesaurus is now available  
NEWS 24 Jun 25 HSDB has been reloaded  
NEWS 25 Jul 16 Data from 1960-1976 added to RDISCLOSURE  
NEWS 26 Jul 21 Identification of STN records implemented  
NEWS 27 Jul 21 Polymer class term count added to REGISTRY  
NEWS 28 Jul 22 INPADOC: Basic index (/BI) enhanced; Simultaneous Left and Right Truncation available  
  
NEWS EXPRESS April 4 CURRENT WINDOWS VERSION IS V6.01a, CURRENT MACINTOSH VERSION IS V6.0b(ENG) AND V6.0Jb(JP), AND CURRENT DISCOVER FILE IS DATED 01 APRIL 2003  
NEWS HOURS STN Operating Hours Plus Help Desk Availability  
NEWS INTER General Internet Information  
NEWS LOGIN Welcome Banner and News Items  
NEWS PHONE Direct Dial and Telecommunication Network Access to STN  
NEWS WWW CAS World Wide Web Site (general information)

Enter NEWS followed by the item number or name to see news on that specific topic.

All use of STN is subject to the provisions of the STN Customer agreement. Please note that this agreement limits use to scientific research. Use for software development or design or implementation

of commercial gateways or other similar uses is prohibited and may result in loss of user privileges and other penalties.

FILE 'HOME' ENTERED AT 15:49:31 ON 23 JUL 2003

=> file caplus  
COST IN U.S. DOLLARS  
SINCE FILE  
ENTRY  
TOTAL  
SESSION  
0.21  
0.21  
FULL ESTIMATED COST

FILE 'CAPLUS' ENTERED AT 15:49:41 ON 23 JUL 2003  
USE IS SUBJECT TO THE TERMS OF YOUR STN CUSTOMER AGREEMENT.  
PLEASE SEE "HELP USAGETERMS" FOR DETAILS.  
COPYRIGHT (C) 2003 AMERICAN CHEMICAL SOCIETY (ACS)

Copyright of the articles to which records in this database refer is held by the publishers listed in the PUBLISHER (PB) field (available for records published or updated in Chemical Abstracts after December 26, 1996), unless otherwise indicated in the original publications. The CA Lexicon is the copyrighted intellectual property of the American Chemical Society and is provided to assist you in searching databases on STN. Any dissemination, distribution, copying, or storing of this information, without the prior written consent of CAS, is strictly prohibited.

FILE COVERS 1907 - 23 Jul 2003 VOL 139 ISS 4  
FILE LAST UPDATED: 22 Jul 2003 (20030722/ED)

This file contains CAS Registry Numbers for easy and accurate substance identification.

=> s 11 and expan?  
277125 EXPAN?  
L2 376 L1 AND EXPAN?

```
=> s 12 and (isenstropic? or isenthaptic?)  
      2500 ISENTROPIC?  
      0 ISENTHAPIC?
```

L3 13 L2 AND (ISENTROPIC? OR ISENTHAPIC?)

=> s 12 and (isentropic? or isenthalpic?)

2500 ISENTROPIC?

175 ISENTHAPIC?

L4 13 L2 AND (ISENTROPIC? OR ISENTHAPIC?)

=> s 14 and (GTL or gas (1a)liquid)

211 GTL

3 GTLS

213 GTL

(GTL OR GTLS)

1303512 GAS

445177 GASES

1466711 GAS

(GAS OR GASES)

630354 LIQUID

114069 LIQUIDS

718583 LIQUID

(LIQUID OR LIQUIDS)

857168 LIQ

81425 LIQS

888601 LIQ

(LIQ OR LIQS)

1249310 LIQUID

(LIQUID OR LIQ)

78848 GAS (1A)LIQUID

L5 2 L4 AND (GTL OR GAS (1A)LIQUID)

=> s 14 ibib ab 1-13

MISSING OPERATOR L4 IBIB

The search profile that was entered contains terms or nested terms that are not separated by a logical operator.

=> d 14 ibib ab 1-13

L4 ANSWER 1 OF 13 CAPLUS COPYRIGHT 2003 ACS on STN

ACCESSION NUMBER: 2003:390719 CAPLUS

DOCUMENT NUMBER: 138:387864

TITLE: Self-refrigerated LNG process

INVENTOR(S): Fischer-Calderon, Ernesto

PATENT ASSIGNEE(S): BP Corporation North America Inc., USA

SOURCE: U.S., 10 pp.

CODEN: USXXAM

DOCUMENT TYPE: Patent

LANGUAGE: English

FAMILY ACC. NUM. COUNT: 1

PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
US 6564578	B1	20030520	US 2002-50922	20020118
PRIORITY APPLN. INFO.:			US 2002-50922	20020118

AB The present invention is directed to a process for producing LNG by directing a feed stream comprising natural gas to a cooling stage that (a) cools the feed stream in at least one cooling step producing a cooled feed stream, (b) expands the cooled feed stream in at least one expansion step by reducing the pressure of the cooled feed stream producing a refrigerated vapor component and a liq. component, and (c) separates at least a portion of the refrigerated vapor component from the liq. component wherein at least a portion of the cooling for the process is derived from at least a portion of the refrigerated vapor component;

and repeating steps (a) through (c) one or more times until at least substantial portion of the feed stream in the 1st cooling stage is processed into LNG wherein the feed stream in step (a) comprises at least a portion of the liq. component produced from a previous cooling stage.

REFERENCE COUNT: 61 THERE ARE 61 CITED REFERENCES AVAILABLE FOR THIS RECORD. ALL CITATIONS AVAILABLE IN THE RE FORMAT

L4 ANSWER 2 OF 13 CAPLUS COPYRIGHT 2003 ACS on STN  
ACCESSION NUMBER: 1999:388352 CAPLUS  
DOCUMENT NUMBER: 131:21216  
TITLE: **Natural gas liquefaction**  
process and apparatus  
INVENTOR(S): Dubar, Christopher Alfred Timothy  
PATENT ASSIGNEE(S): BHP Petroleum Pty. Ltd., Australia  
SOURCE: PCT Int. Appl., 24 pp.  
CODEN: PIXXD2  
DOCUMENT TYPE: Patent  
LANGUAGE: English  
FAMILY ACC. NUM. COUNT: 1  
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
WO 9930094	A1	19990617	WO 1998-GB3708	19981211
W: AU, JP, US				
RW: AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE				
AU 9914977	A1	19990628	AU 1999-14977	19981211
AU 752201	B2	20020912		
EP 1038146	A1	20000927	EP 1998-959046	19981211
R: DE, FR, GB				
JP 2001526376	T2	20011218	JP 2000-524622	19981211
US 6446465	B1	20020910	US 2001-951725	20010914
PRIORITY APPLN. INFO.:			GB 1997-26297	A 19971211
			WO 1998-GB3708	W 19981211
			US 2000-581341	A1 20000821

AB App. for **liquefying natural gas** comprises a series of heat exchangers for cooling the natural gas in countercurrent heat exchange relationship with a refrigerant, compression means for compressing the refrigerant, **expansion** means for **isentropically expanding** at least two sep. streams of the compressed refrigerant, the **expanded** streams of refrigerant communicating with a cool end of a resp. one of the heat exchangers, and a precooling refrigeration system for precooling the natural gas to a temp. <0.degree. before it is fed to the series of heat exchangers, and for precooling the compressed refrigerant discharged from a warm end of the series of heat exchangers to a temp. <0.degree. before it is fed back into the series of heat exchanges or to the **expansion** means.

REFERENCE COUNT: 4 THERE ARE 4 CITED REFERENCES AVAILABLE FOR THIS RECORD. ALL CITATIONS AVAILABLE IN THE RE FORMAT

L4 ANSWER 3 OF 13 CAPLUS COPYRIGHT 2003 ACS on STN  
ACCESSION NUMBER: 1998:498159 CAPLUS  
DOCUMENT NUMBER: 129:205073  
TITLE: **Natural gas liquefaction**  
method  
INVENTOR(S): Yoshikawa, Yoshitsugu; Yamamoto, Osamu; Nakamura, Moritaka; Sugiyama, Shigeru; Fukuda, Seiji  
PATENT ASSIGNEE(S): Chiyoda Chemical Engineering Construction Co., Japan  
SOURCE: Jpn. Kokai Tokkyo Koho, 8 pp.  
CODEN: JKXXAF  
DOCUMENT TYPE: Patent

LANGUAGE: Japanese

FAMILY ACC. NUM. COUNT: 1

PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
JP 10204455	A2	19980804	JP 1997-12670	19970127
US 6062041	A	20000516	US 1997-974824	19971120
PRIORITY APPLN. INFO.:			JP 1997-12670	19970127

AB The method comprises **liquefying natural gas** feed and recycle gas by utilizing a single-component refrigerant or a mixed refrigerant in a high temp. state, and with a substantially **isentropic expansion** in a low temp. stage, pressurizing the non-liquefied part of the recycle gas in a compressor, recycling the nonliquefied part of the feed natural gas, and then recovering the liquefied part by the refrigerant exchanging heat with the non-liquefied part stream produced from the substantially **isentropic expansion**, in a plate-fin heat exchanger or the like. The mixed refrigerant may contain CH<sub>4</sub>, C<sub>2</sub>H<sub>5</sub>, C<sub>3</sub>H<sub>8</sub>, C<sub>3</sub>H<sub>6</sub> and C<sub>4</sub>H<sub>8</sub>.

L4 ANSWER 4 OF 13 CAPLUS COPYRIGHT 2003 ACS on STN

ACCESSION NUMBER: 1997:536516 CAPLUS

DOCUMENT NUMBER: 127:192714

TITLE: Increasing liquid hydrocarbon recovery from natural gas: evaluation of the vortex-tube device

AUTHOR(S): Hajdik, Brock; Erdol, Jurgen Steinle - Beb; Lorey, Manfred; Thomas, Keith

CORPORATE SOURCE: CBS Engineering, Houston, TX, USA

SOURCE: Proceedings, Annual Convention - Gas Processors Association (1997), 76th, 219-226

CODEN: PGPAAC; ISSN: 0096-8870

PUBLISHER: Gas Processors Association

DOCUMENT TYPE: Journal

LANGUAGE: English

AB The vortex-tube device provides a useful addn. to the range of equipment available to the gas industry. The use of vortex-tube equipment permits improved sepn. in comparison with a Joule-Thomson system, without entering into the cost and complexity of a true **isentropic** system such as a **turbo-expander** unit. The comparative advantage of the vortex tube depends upon the inlet conditions of the gas and the pressure drop that is available. An optimum pressure drop of 25 - 35 % of the inlet gas pressure has been confirmed in practice. Although not yet tested on operating plant, it is expected that a loss of performance of vortex-tube units will occur for inlet liq.-to-gas ratios of greater than 20%. Units with up to 5% liq. at the inlet have been successfully operated showing that a single phase gas at the unit inlet is not essential. It is expected that future application of vortex tube units will be concd. where performance improvements over Joule-Thomson units, at low capital cost, are required.

L4 ANSWER 5 OF 13 CAPLUS COPYRIGHT 2003 ACS on STN

ACCESSION NUMBER: 1997:467217 CAPLUS

DOCUMENT NUMBER: 127:111022

TITLE: Power recovery through thermodynamic **expansion** of liquid methane

AUTHOR(S): Cengel, Yunus A.; Kimmel, Hans

CORPORATE SOURCE: Department of Mechanical Engineering, University of Nevada, Reno, Reno, NV, USA

SOURCE: Proceedings of the American Power Conference (1997), 59(1), 271-276

CODEN: PAPWA2; ISSN: 0097-2126  
PUBLISHER: American Power Conference

DOCUMENT TYPE: Journal  
LANGUAGE: English

AB Thermodn. aspects of a cryogenic turbine-generator assembly that admits methane at a high pressure and discharges it at a low pressure are investigated. The entire turbine-generator assembly is submerged in methane. The study is intended to quantify the effect of the turbine generator assembly on the exit temp. of methane, the rate of heat transfer to methane, the rate of internal heat generation due to the hydraulic inefficiency of the turbine and the heat given off by generator, and the resulting temp. rise of methane, the amt. of elec. power generated and potential revenues from it. The submerged turbine-generator assembly appears to be very attractive both thermodynamically and economically. The unit will put the power generation potential of the liq. methane into best use while actually lowering the temp. of liq. methane. The exit temp. of liq. methane as it **expands** from 113.0 K and 4.479 MPa to 0.517 MPa will range from 112.0 K in the case of an **isentropic** turbine, to 114.6 K in the case of an **expansion** valve. In the case of 75% efficient submerged turbine-generator assembly, the exit temp. will be 112.6 K. Therefore, the temp. of methane will rise by 1.6 K in the **expansion** valve, but it will drop by 0.4 K in the turbine-generator assembly, making this system very desirable in cryogenic applications. Heat transfer to the container of the turbine generator assembly appears to be very small, and the temp. rise of methane due to this heat gain is negligible (under 0.007 K). The system investigated has a power generation potential of 1085 kW, but because of the inefficiencies in the turbine and the generator, it is realistic to expect to generate about 814 kW of elec. power. The turbine-generator assembly will save the facility about half a million dollars a year in electricity costs if the facility operates continuously.

L4 ANSWER 6 OF 13 CAPLUS COPYRIGHT 2003 ACS on STN

ACCESSION NUMBER: 1997:358930 CAPLUS

DOCUMENT NUMBER: 126:332449

TITLE: Liquefaction apparatus for natural gas using heat exchangers on a ship

INVENTOR(S): Dubar, Christopher Alfred Timot; Leh Ming Tu, Oliver

PATENT ASSIGNEE(S): Bhp Petroleum Pty. Ltd., Australia; Dubar, Christopher Alfred Timothy; Leh Ming Tu, Oliver

SOURCE: PCT Int. Appl., 58 pp.

CODEN: PIXXD2

DOCUMENT TYPE: Patent

LANGUAGE: English

FAMILY ACC. NUM. COUNT: 2

PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
WO 9713108	A1	19970410	WO 1996-GB2434	19961004
W:	AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GE, HU, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, TJ, TM, TR, TT, UA, UG, US, UZ, VN, AM, AZ, BY, KG, KZ, MD, RU, TJ, TM			
RW:	KE, LS, MW, SD, SZ, UG, AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, BF, BJ, CF, CG			
AU 9671396	A1	19970428	AU 1996-71396	19961004
EP 857285	A1	19980812	EP 1996-932719	19961004
EP 857285	B1	20030423		
R:	AT, BE, CH, DE, DK, ES, FR, GB, GR, IT, LI, LU, NL, SE, MC, PT, IE, FI			
RU 2141084	C1	19991110	RU 1998-108464	19961004
JP 2000513757	T2	20001017	JP 1997-514076	19961004

AT 238529	E	20030515	AT 1996-932719	19961004
NO 9801514	A	19980603	NO 1998-1514	19980403
AU 754108	B2	20021107	AU 2000-42610	20000622
PRIORITY APPLN. INFO.:			GB 1995-20303	A 19951005
			GB 1995-20348	A 19951005
			GB 1995-20349	A 19951005
			GB 1995-20356	A 19951005
			WO 1996-GB2434	W 19961004

AB An offshore app. for **liquefying natural gas** comprises a support structure which is either floatable or is otherwise adapted to be disposed in an offshore location at least partially above sea level, and **natural gas liquefaction** means disposed on or in the support structures. The **natural gas liquefaction** means comprises a series of heat exchangers for cooling the natural gas in countercurrent heat exchange relation with a refrigerant, compression means for compressing the refrigerant, and **expansion** means for **isentropically expanding** at least two sep. streams of the compressed refrigerant, wherein said **expanded** streams of refrigerant communicate with a cool end of a resp. one of the heat exchangers.

L4 ANSWER 7 OF 13 CAPLUS COPYRIGHT 2003 ACS on STN  
 ACCESSION NUMBER: 1997:342436 CAPLUS  
 DOCUMENT NUMBER: 126:319308  
 TITLE: Liquefaction process  
 INVENTOR(S): Dubar, Christopher Alfred Timot  
 PATENT ASSIGNEE(S): Bhp Petroleum Pty. Ltd., Australia; Dubar, Christopher Alfred Timothy  
 SOURCE: PCT Int. Appl., 57 pp.  
 CODEN: PIXXD2  
 DOCUMENT TYPE: Patent  
 LANGUAGE: English  
 FAMILY ACC. NUM. COUNT: 2  
 PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
WO 9713109	A1	19970410	WO 1996-GB2443	19961004
W: AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GE, HU, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, TJ, TM, TR, TT, UA, UG, US, UZ, VN, AM, AZ, BY, KG, KZ, MD, RU, TJ, TM				
RW: KE, LS, MW, SD, SZ, UG, AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, BF, BJ, CF, CG				
AU 9671401	A1	19970428	AU 1996-71401	19961004
AU 718068	B2	20000406		
EP 862717	A1	19980909	EP 1996-932725	19961004
EP 862717	B1	20030312		
R: AT, BE, CH, DE, DK, ES, FR, GB, GR, IT, LI, LU, NL, SE, MC, PT, IE, FI				
RU 2141611	C1	19991120	RU 1998-108463	19961004
JP 2000506591	T2	20000530	JP 1997-514081	19961004
AT 234450	E	20030315	AT 1996-932725	19961004
NO 9801515	A	19980603	NO 1998-1515	19980403
US 5916260	A	19990629	US 1998-51221	19980713
AU 754108	B2	20021107	AU 2000-42610	20000622
PRIORITY APPLN. INFO.:			GB 1995-20303	A 19951005
			GB 1995-20348	A 19951005
			GB 1995-20349	A 19951005
			GB 1995-20356	A 19951005
			WO 1996-GB2443	W 19961004

AB A natural gas liquefaction process comprises passing natural gas through a series of heat exchangers in countercurrent relationship with a gaseous refrigerant circulated through work expansion cycle. The work expansion cycle comprises compressing the refrigerant, dividing and cooling the refrigerant to produce at least first and second cooled refrigerant streams, substantially isentropically expanding the first refrigerant stream to a coolest refrigerant temp., substantially isentropically expanding the second refrigerant stream to an intermediate refrigerant temp. warmer than the coolest refrigerant temp., and delivering the refrigerant in the first and second refrigerant streams to a resp. heat exchanger for cooling the natural gas thorough corresponding temp. ranges. The refrigerant in the first stream is isentropically expanded to a pressure at least 10 times greater than the total pressure drop of the first refrigerant stream across the series of heat exchangers, the pressure being in the range of 1.2-2.5 MPa.

L4 ANSWER 8 OF 13 CAPLUS COPYRIGHT 2003 ACS on STN

ACCESSION NUMBER: 1994:439057 CAPLUS  
DOCUMENT NUMBER: 121:39057  
TITLE: Method for liquefying natural gas.  
INVENTOR(S): Kikkawa, Yoshitsugi; Yamamoto, Osamu; Sakaguchi, Junichi; Nakamura, Moritaka  
PATENT ASSIGNEE(S): Chiyoda Corp., Japan  
SOURCE: Eur. Pat. Appl., 21 pp.  
CODEN: EPXXDW  
DOCUMENT TYPE: Patent  
LANGUAGE: English  
FAMILY ACC. NUM. COUNT: 1  
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
EP 599443	A1	19940601	EP 1993-301750	19930308
EP 599443	B1	19970917		
R: DE, FR, GB, IT, NL				
JP 06159928	A2	19940607	JP 1992-335540	19921120
CA 2090809	AA	19940521	CA 1993-2090809	19930302
CA 2090809	C	19970408		
US 5363655	A	19941115	US 1993-28025	19930308
PRIORITY APPLN. INFO.:			JP 1992-335540	19921120

AB The method for liquefying natural gas can be readily adapted to LNG plants of all sizes without requiring expensive and special heat exchangers. The liquefaction of feed gas of natural gas and recycle natural gas is carried out with a single-component refrigerant or a mixed refrigerant in a high temp. state, and with a substantially isentropic expansion in a low temp. stage, and a non-liquefied part of the recycle gas after the expansion step is pressurized with a compressor and recycled along with a recycle stream of nonliquefied part of the feed natural gas, the liquefied part by the refrigerant exchanging heat with the non-liquefied part stream produced from the substantially isentropic expansion, in a plate-fin heat exchanger or the like. The compressor is driven by the power obtained by the substantially isentropic expansion.

L4 ANSWER 9 OF 13 CAPLUS COPYRIGHT 2003 ACS on STN

ACCESSION NUMBER: 1989:557278 CAPLUS  
DOCUMENT NUMBER: 111:157278  
TITLE: Reliquefaction of boil-off from liquefied

INVENTOR(S): **natural gas**  
 Cook, Philip J.  
 PATENT ASSIGNEE(S): Air Products and Chemicals, Inc., USA  
 SOURCE: U.S., 9 pp.  
 CODEN: USXXAM  
 DOCUMENT TYPE: Patent  
 LANGUAGE: English  
 FAMILY ACC. NUM. COUNT: 1  
 PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
US 4846862	A	19890711	US 1988-241158	19880906
EP 358100	A2	19900314	EP 1989-116028	19890830
EP 358100	A3	19900718		
EP 358100	B1	19940119		
R: BE, DE, ES, FR, GB, NL				
JP 02106688	A2	19900418	JP 1989-227308	19890901
CN 1041034	A	19900404	CN 1989-106910	19890906
CN 1016267	B	19920415		

PRIORITY APPLN. INFO.: US 1988-241158 19880906  
 AB In a process for the reliquefaction of boil-off gas contg. <10% N2  
 resulting from the evapn. of **liquefied natural**  
**gas** (LNG) contained in a storage vessel, a closed-loop  
 refrigeration cycle is utilized where an **isenthalpically**  
**expanded** stream is warmed against an initially cooled boil-off  
 stream. The boil-off LNG stream is initially cooled by indirect heat  
 exchange with an **isentropically expanded** refrigerant  
 stream.

L4 ANSWER 10 OF 13 CAPLUS COPYRIGHT 2003 ACS on STN  
 ACCESSION NUMBER: 1984:425901 CAPLUS  
 DOCUMENT NUMBER: 101:25901  
 TITLE: Liquefying methane  
 INVENTOR(S): Newton, Charles Leo  
 PATENT ASSIGNEE(S): Air Products and Chemicals, Inc., USA  
 SOURCE: Eur. Pat. Appl., 39 pp.  
 CODEN: EPXXDW  
 DOCUMENT TYPE: Patent  
 LANGUAGE: English  
 FAMILY ACC. NUM. COUNT: 1  
 PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
EP 102087	A2	19840307	EP 1983-108546	19830830
EP 102087	A3	19850116		
EP 102087	B1	19861230		
R: BE, DE, FR, GB, IT, NL, SE				
US 4445916	A	19840501	US 1982-412686	19820830
CA 1200191	A1	19860204	CA 1983-435183	19830823
NO 8303100	A	19840301	NO 1983-3100	19830829
NO 160600	B	19890123		
NO 160600	C	19890503		
ES 525205	A1	19850901	ES 1983-525205	19830829
JP 59081483	A2	19840511	JP 1983-158934	19830830
JP 04009987	B4	19920221		
AU 8318692	A1	19840308	AU 1983-18692	19830905
AU 553598	B2	19860724		

PRIORITY APPLN. INFO.: US 1982-412686 19820830  
 AB A process for **liquefying natural gas** is  
 disclosed in which heavier hydrocarbons are sepd. in a scrub column from

the natural gas prior to liquefaction. The feed to the scrub column is intercooled against the CH<sub>4</sub>-rich overhead from the column and **isentropically expanded** before introduction to the column, and sepd. from the heavier hydrocarbons. The CH<sub>4</sub>-rich overheads is compressed utilizing the mech. energy of **expansion** and liquefied in a refrigerated heat exchanger.

L4 ANSWER 11 OF 13 CAPLUS COPYRIGHT 2003 ACS on STN

ACCESSION NUMBER: 1979:525899 CAPLUS  
 DOCUMENT NUMBER: 91:125899  
 TITLE: Nitrogen-methane separation process and system  
 INVENTOR(S): Yearout, James D.  
 PATENT ASSIGNEE(S): USA  
 SOURCE: U.S., 12 pp.  
 CODEN: USXXAM  
 DOCUMENT TYPE: Patent  
 LANGUAGE: English  
 FAMILY ACC. NUM. COUNT: 1  
 PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
US 4158556	A	19790619	US 1977-786130	19770411

PRIORITY APPLN. INFO.: US 1977-786130 19770411

AB Pipeline-quality natural gas contg. .1toreq.7% N is produced from natural gas mixts. contg. .apprx.15-80% N by a low-temp. distn. process in which the mixt. is charged at a pressure significantly below the crit. pressure for the mixt. (i.e., <700 psia), and nonadiabatic or differential distn. is used to provide max. thermodn. efficiency. The raw feedstock is subjected to regenerative heat exchange (e.g., with cold waste N) to cool it to near its satn. point, and the cooled feed is charged to a fractionation column operating at substantially the same pressure. The mixt. is sepd. in the column; and the N withdrawn overhead is cooled by being work-**expanded**, recycled to provide refrigeration for the column, and used to cool the feed in a heat exchanger. The **liquefied natural gas** is withdrawn from the lower part of the column and partly flashed to reduce its temp. prior to evapn. in the case of a gas-producing plant or prior to **isentropic expansion** to liq. storage in the case of a liq.-producing plant. Prior to the distn. process, CO<sub>2</sub> can be removed from the raw feed gas by the use of refrigerated MeOH [67-56-1] as an absorbent.

L4 ANSWER 12 OF 13 CAPLUS COPYRIGHT 2003 ACS on STN

ACCESSION NUMBER: 1978:139091 CAPLUS  
 DOCUMENT NUMBER: 88:139091  
 TITLE: Liquefied methane  
 INVENTOR(S): Newton, Charles L.; Gaumer, Lee S.  
 PATENT ASSIGNEE(S): Air Products and Chemicals, Inc., USA  
 SOURCE: U.S., 6 pp.  
 CODEN: USXXAM  
 DOCUMENT TYPE: Patent  
 LANGUAGE: English  
 FAMILY ACC. NUM. COUNT: 1  
 PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
US 4065278	A	19771227	US 1976-673162	19760402
JP 61016908	B4	19860502	JP 1977-139788	19771121
JP 54072203	A2	19790609		

PRIORITY APPLN. INFO.: US 1976-673162 19760402

AB A process is disclosed for producing **liquefied natural**

gas from a feedstock contg. 60-90 mol % CH<sub>4</sub> [74-82-8]. Thus, the feedstock at .gtoreq.860 psia is cooled to .apprx.70.degree.F and **isentropically expanded** to 480 psia, which cools the feed to .apprx.-72.degree.F. The product is fractionated at 200-650 psia to form an overhead rich in CH<sub>4</sub> and a bottoms fraction. The overhead is compressed utilizing energy obtained from the **expansion** and then liquefied in a refrigeration cycle.

L4 ANSWER 13 OF 13 CAPLUS COPYRIGHT 2003 ACS on STN  
ACCESSION NUMBER: 1975:46083 CAPLUS  
DOCUMENT NUMBER: 82:46083  
TITLE: Liquefaction of gases using multistage **isentropic expansion** in the region of moist vapor  
AUTHOR(S): Bochaver, K. Z.; Brodetskaya, D. Z.; Ivanova, V. I.; Startsev, A. A.  
CORPORATE SOURCE: USSR  
SOURCE: Neftepererabotka i Neftekhimiya (Vsesoyuznoe Ob'edinenie Neftekhim) (1972), 1, 281-8  
CODEN: NPNKA5  
DOCUMENT TYPE: Journal  
LANGUAGE: Russian  
AB A method of **expansion** of gases, in the region of moist vapor, was investigated, which enabled the moisture content of vapor to be reduced in the circulating part of a compressed air driven turbine-compressor, and thereby increased the efficiency of **expansion** in the turbine. Calcns. and plans were made for a turbine, driven by compressed gas, with centripetal and axial stages, and a multistage axial part. The variant recommended, secured an efficiency of compression, by **expansion** of 0.715. The machine had increased stability to corrosion due to low moisture content at each stage, through intermediate sepn.; less peripheral speed; feed of vapor formed by throttling liq. in discharge separator to discharge at the edge of the nozzle.

3. Document ID: US 6412302 B1

L18: Entry 3 of 23

File: USPT

Jul 2, 2002

US-PAT-NO: 6412302  
DOCUMENT-IDENTIFIER: US 6412302 B1

TITLE: LNG production using dual independent expander refrigeration cycles

DATE-ISSUED: July 2, 2002

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Foglietta, Jorge H.	Missouri City	TX		

ASSIGNEE-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY	TYPE	CODE
ABB Lummus Global, Inc. - Randall Division	Houston	TX			02	

APPL-NO: 09/ 828551 [PALM]

DATE FILED: April 6, 2001

PARENT-CASE:

This application claims the benefits of provisional patent application, U.S. Ser. No. 60/273,531, filed on Mar. 6, 2001.

INT-CL: [07] F25 J 1/00, F25 J 3/00

US-CL-ISSUED: 62/611; 62/619

US-CL-CURRENT: 62/611; 62/619

FIELD-OF-SEARCH: 62/611, 62/612, 62/613, 62/614, 62/619, 62/912, 62/606

PRIOR-ART-DISCLOSED:

U.S. PATENT DOCUMENTS

PAT-NO	ISSUE-DATE	PATENTEE-NAME	US-CL
<u>4057972</u>	November 1977	Sarsten	62/612
<u>4461634</u>	July 1984	Duckett et al.	62/611
<u>4755200</u>	July 1988	Liu et al.	62/612
<u>4911741</u>	March 1990	Davis et al.	62/613
<u>5036671</u>	August 1991	Nelson et al.	62/612
<u>5651269</u>	July 1997	Prevost et al.	62/613
<u>5755114</u>	May 1998	Foglietta	62/618
<u>6041619</u>	March 2000	Fischer et al.	62/612
<u>6105389</u>	August 2000	Paradowski et al.	62/613

ART-UNIT: 3744

PRIMARY-EXAMINER: Doerrler, William C.

## ABSTRACT:

A process for producing a liquified natural gas stream that includes cooling at least a portion of a pressurized natural gas feed stream by heat exchange contact with first and second expanded refrigerants that are used in independent refrigeration cycles. The first expanded refrigerant is selected from methane, ethane and treated and pressurized natural gas. The second expanded refrigerant is nitrogen.

21 Claims, 4 Drawing figures

Full	Title	Citation	Front	Review	Classification	Date	Reference	Sequences	Attachments	KOMC
Drawn Desc   Image										

4. Document ID: US 6395197 B1

L18: Entry 4 of 23

File: USPT

May 28, 2002

US-PAT-NO: 6395197

DOCUMENT-IDENTIFIER: US 6395197 B1

TITLE: Hydrogen and elemental carbon production from natural gas and other hydrocarbons

DATE-ISSUED: May 28, 2002

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Detering; Brent A.	Idaho Falls	ID		
Kong; Peter C.	Idaho Falls	ID		

ASSIGNEE-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY	TYPE CODE
Bechtel BWXT Idaho LLC	Idaho Falls	ID			02

APPL-NO: 09/ 732451 [PALM]

DATE FILED: December 6, 2000

PARENT-CASE:

RELATED APPLICATION This application claims priority from United States provisional application Ser. No. 60/172,976 filed on Dec. 21, 1999 and is incorporated by reference.

INT-CL: [07] C07 C 1/02, C01 B 31/18, C01 B 31/00, C01 B 3/02, C01 B 3/24

US-CL-ISSUED: 252/373; 423/418.2, 423/445R, 423/648.1, 423/650

US-CL-CURRENT: 252/373; 423/418.2, 423/445R, 423/648.1, 423/650

FIELD-OF-SEARCH: 252/373, 423/418.2, 423/445R, 423/648.1, 423/650

PRIOR-ART-DISCLOSED:

U.S. PATENT DOCUMENTS

PAT-NO	ISSUE-DATE	PATENTEE-NAME	US-CL
<u>5409784</u>	April 1995	Bromberg et al.	429/13
<u>5425332</u>	June 1995	Rabinovich et al.	123/3
<u>5437250</u>	August 1995	Rabinovich et al.	219/121.48
<u>5481080</u>	January 1996	Lynum et al.	
<u>5500501</u>	March 1996	Lynum et al.	219/212.48
<u>5527518</u>	June 1996	Lynum et al.	423/449.1
<u>5725616</u>	March 1998	Lynum et al.	48/127.3
<u>5749937</u>	May 1998	Detering et al.	75/10.19
<u>5852927</u>	December 1998	Cohn et al.	60/39.05
<u>5887554</u>	March 1999	Cohn et al.	123/3

#### FOREIGN PATENT DOCUMENTS

FOREIGN-PAT-NO	PUBN-DATE	COUNTRY	US-CL
0 618 951	September 1996	EP	
PCT/NO92/00200	January 1992	WO	

ART-UNIT: 1621

PRIMARY-EXAMINER: Richter; Johann

ASSISTANT-EXAMINER: Parsa; J.

ATTY-AGENT-FIRM: Workman Nydegger & Seeley

#### ABSTRACT:

Diatomeric hydrogen and unsaturated hydrocarbons are produced as reactor gases in a fast quench reactor. During the fast quench, the unsaturated hydrocarbons are further decomposed by reheating the reactor gases. More diatomic hydrogen is produced, along with elemental carbon. Other gas may be added at different stages in the process to form a desired end product and prevent back reactions. The product is a substantially clean-burning hydrogen fuel that leaves no greenhouse gas emissions, and elemental carbon that may be used in powder form as a commodity for several processes.

27 Claims, 12 Drawing figures

<a href="#">Full</a>	<a href="#">Title</a>	<a href="#">Citation</a>	<a href="#">Front</a>	<a href="#">Review</a>	<a href="#">Classification</a>	<a href="#">Date</a>	<a href="#">Reference</a>	<a href="#">Sequences</a>	<a href="#">Attachments</a>
<a href="#">Draw Desc</a>	<a href="#">Image</a>								

KM/C

#### 5. Document ID: US 6082133 A

L18: Entry 5 of 23

File: USPT

Jul 4, 2000

US-PAT-NO: 6082133

DOCUMENT-IDENTIFIER: US 6082133 A

TITLE: Apparatus and method for purifying natural gas via cryogenic separation

DATE-ISSUED: July 4, 2000

#### INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Barclay; Michael A.	Redmond	WA		
Brook; Thomas C.	Victoria			CA
Barclay; John A.	Redmond	WA		
Tison; Raymond R.	Mentor	OH		

ASSIGNEE-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY	TYPE CODE
Cryo Fuel Systems, Inc	Redmond	WA			02

APPL-NO: 09/ 245570 [PALM]  
 DATE FILED: February 5, 1999

INT-CL: [07] E25 I 1/00

US-CL-ISSUED: 62/619, 62/637, 62/909  
 US-CL-CURRENT: 62/619, 62/637, 62/909

FIELD-OF-SEARCH: 62/619, 62/637, 62/908, 62/909

PRIOR-ART-DISCLOSED:

U.S. PATENT DOCUMENTS

PAT-NO	ISSUE-DATE	PATENTEE-NAME	US-CL
<u>3093470</u>	June 1963	Melikian et al.	62/637
<u>4283212</u>	August 1981	Graham et al.	62/908
<u>5737941</u>	April 1998	Hsiung et al.	62/908
<u>5740682</u>	April 1998	Lavie	62/908

ART-UNIT: 374

PRIMARY-EXAMINER: Capossela; Ronald

ATTY-AGENT-FIRM: Ward; Calvin B.

ABSTRACT:

An apparatus for separating CO.<sub>sub.2</sub> from a mixture of gases includes CO.<sub>sub.2</sub> and a second gas, the apparatus includes an active heat exchanger and a regenerating heat exchanger. The active heat exchanger includes a heat exchange surface in contact with the mixture of gases. The mixture of gases is present in the active heat exchanger at a predetermined pressure which is chosen such that CO.<sub>sub.2</sub> freezes on the heat exchange surface when the surface is cooled by a refrigerant having a temperature below that at which CO.<sub>sub.2</sub> freezes at the predetermined pressure. The regenerating heat exchanger includes a heat exchange surface in contact with the refrigerant and also in contact with a layer of frozen CO.<sub>sub.2</sub>. The refrigerant enters the regenerating heat exchanger at a temperature above that at which the CO.<sub>sub.2</sub> in the frozen layer of CO.<sub>sub.2</sub> sublimates. The sublimation of the solid CO.<sub>sub.2</sub> cools the refrigerant prior to the refrigerant being expanded through an expansion valve, which reduces the temperature of the refrigerant to a point below the freezing point of CO.<sub>sub.2</sub> at the predetermined pressure. The refrigerant is re-compressed by a compressor after leaving the active heat exchanger. In the preferred embodiment of the present invention, the gaseous CO.<sub>sub.2</sub> released by the regenerating heat exchanger is used to precool the incoming gas mixture. A second precooling heat exchanger precools the compressed refrigerant by providing thermal contact with the refrigerant leaving the active heat exchanger.

5 Claims, 3 Drawing figures

6. Document ID: US 5651269 A

L18: Entry 6 of 23

File: USPT

Jul 29, 1997

US-PAT-NO: 5651269

DOCUMENT-IDENTIFIER: US 5651269 A

TITLE: Method and apparatus for liquefaction of a natural gas

DATE-ISSUED: July 29, 1997

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Prevost; Isabelle	Conflans Sainte Honorine			FR
Rojey; Alexandre	Rueil Malmaison			FR

ASSIGNEE-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY	TYPE CODE
Institut Francais du Petrole	Rueil Malmaison			FR	03

APPL-NO: 08/ 507277 [PALM]

DATE FILED: August 30, 1995

FOREIGN-APPL-PRIORITY-DATA:

COUNTRY	APPL-NO	APPL-DATE
FR	93 15924	December 30, 1993
FR	94 02024	February 21, 1994

PCT-DATA:

APPL-NO	DATE-FILED	PUB-NO	PUB-DATE	371-DATE	102 (E) -DATE
PCT/FR94/01535	December 26, 1994	WO95/18345	Jul 6, 1995	Aug 30, 1995	Aug 30, 1995

INT-CL: [06] E25 I 3/00

US-CL-ISSUED: 62/613

US-CL-CURRENT: 62/613

FIELD-OF-SEARCH: 62/613

PRIOR-ART-DISCLOSED:

U.S. PATENT DOCUMENTS

PAT-NO	ISSUE-DATE	PATENTEE-NAME	US-CL
<u>2903858</u>	September 1959	Bocquet	62/613

ART-UNIT: 344

PRIMARY-EXAMINER: Capossela; Ronald C.

ATTY-AGENT-FIRM: Antonelli, Terry, Stout & Kraus, LLP

ABSTRACT:

The method of the invention for liquefying a natural gas consists in liquefying at least a part of this gas by expanding it with mechanical energy, whereby during this expansion the gas changes from a dense phase to a liquid phase without undergoing a phase transition.

24 Claims, 8 Drawing figures

Full	Title	Citation	Front	Review	Classification	Date	Reference	Sequences	Attachments	KWIC
Draw Desc	Image									

7. Document ID: US 5615561 A

L18: Entry 7 of 23

File: USPT

Apr 1, 1997

US-PAT-NO: 5615561

DOCUMENT-IDENTIFIER: US 5615561 A

TITLE: LNG production in cryogenic natural gas processing plants

DATE-ISSUED: April 1, 1997

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Houshmand; Mory	Salt Lake City	UT		
Kruger; Kimberly A.	Salt Lake City	UT		
Alves; Gerald W.	Sugar Land	TX		
Ostaszewski; Ricardo	Sugar Land	TX		
Belhateche; Noureddine	Katy	TX		

ASSIGNEE-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY	TYPE	CODE
Williams Field Services Company	Salt Lake City	UT				02

APPL-NO: 08/ 335902 [PALM]

DATE FILED: November 8, 1994

INT-CL: [06] E25 I 1/00

US-CL-ISSUED: 62/611; 62/620

US-CL-CURRENT: 62/611; 62/620

FIELD-OF-SEARCH: 62/9, 62/11, 62/13, 62/23, 62/42, 62/24, 62/620, 62/611

PRIOR-ART-DISCLOSED:

U.S. PATENT DOCUMENTS

PAT-NO	ISSUE-DATE	PATENTEE-NAME	US-CL
<u>3195316</u>	July 1965	Maher et al.	62/52
<u>3299646</u>	January 1967	Stuart et al.	62/40
<u>3724226</u>	April 1973	Pachaly	62/39
<u>3735600</u>	May 1973	Dowdell et al.	62/39
<u>4033735</u>	July 1977	Swenson	62/9
<u>4274849</u>	June 1981	Garier et al.	62/9
<u>4339253</u>	July 1982	Caetani et al.	62/40
<u>4456459</u>	June 1984	Brundige, Jr.	62/9
<u>4539028</u>	September 1985	Paradowski et al.	62/9
<u>4566885</u>	January 1986	Haak	62/9
<u>4680041</u>	July 1987	DeLong	62/23 X
<u>4687499</u>	August 1987	Aghili	62/42 X
<u>4711651</u>	December 1987	Sharma et al.	62/23 X
<u>4746342</u>	May 1988	DeLong et al.	62/24
<u>4805413</u>	February 1989	Mitchell et al.	62/42 X
<u>5036671</u>	August 1991	Nelson et al.	62/23
<u>5089034</u>	February 1992	Markovs et al.	55/28
<u>5275005</u>	January 1994	Campbell et al.	62/24
<u>5359856</u>	November 1994	Rhoades et al.	62/9
<u>5363655</u>	November 1994	Kikkawa et al.	62/9
<u>5402645</u>	April 1995	Johnson et al.	62/23

#### OTHER PUBLICATIONS

"LNG Supply", LNG Express, vol. IV, No. 1, pp. 1-4, Copyright 1994, Zeus Development Corporation.

ART-UNIT: 344

PRIMARY-EXAMINER: Kilner; Christopher

ATTY-AGENT-FIRM: Goodall; Eleanor V. Christiansen; Jon C.

#### ABSTRACT:

A method and system for liquefying natural gas using a cryogenic process is described. The method is well suited for producing high methane purity natural gas which can be used as a vehicle fuel. The invention utilizes residue gas from a cryogenic plant as a natural gas feedstock. The natural gas feedstock is condensed by heat exchange with overhead gas from the demethanizer of the cryogenic plant. In the preferred embodiment of the invention the pressure of the condensed natural gas is reduced to a level at which it can be readily stored and transported by expansion through one or more Joule-Thomson valves.

59 Claims, 10 Drawing figures

Full	Title	Citation	Front	Review	Classification	Date	Reference	Sequences	Attachments	KMC
<a href="#">Draw</a>	<a href="#">Desc</a>	<a href="#">Image</a>								

---

#### 8. Document ID: US 5564277 A

L18: Entry 8 of 23

File: USPT

Oct 15, 1996

US-PAT-NO: 5564277

DOCUMENT-IDENTIFIER: US 5564277 A

TITLE: Dehumidifier for cryogenic refrigeration system

DATE-ISSUED: October 15, 1996

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Martin; Patrick S.	Dallas	TX		

ASSIGNEE-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY	TYPE CODE
General Cryogenics Incorporated	Dallas	TX			02

APPL-NO: 08/ 402849 [PALM]  
DATE FILED: March 31, 1995

PARENT-CASE:

CROSS REFERENCE TO RELATED APPLICATION This is a division of application Ser. No. 08/165,723, filed Dec. 13, 1993, U.S. Pat. No. 5,396,777, which was a division of Ser. No. 08/017,796, filed Feb. 12, 1993, U.S. Pat. No. 5,313,787 which was a division of 07/841,590 filed Feb. 25, 1992 which issued on Apr. 6, 1993 now U.S. Pat. No. 5,199,275, which is a continuation-in-part of application Ser. No. 07/651,206 filed Feb. 6, 1991, entitled "ENTHALPY CONTROL FOR CO.<sub>2</sub> REFRIGERATION SYSTEM", U.S. Pat. No. 5,090,209 which is a continuation-in-part of application Ser. No. 07/591,386 filed Oct. 1, 1990 entitled "CARBON DIOXIDE REFRIGERATION SYSTEM" now U.S. Pat. No. 5,069,039 which issued Dec. 3, 1991.

INT-CL: [06] F25 D 21/06

US-CL-ISSUED: 62/50.3; 62/283, 62/526  
US-CL-CURRENT: 62/50.3; 62/283, 62/526

FIELD-OF-SEARCH: 62/272, 62/283, 62/526, 62/50.1, 62/50.2, 62/50.3, 62/50.4, 62/50.7, 62/51.1, 62/52.1, 62/80

PRIOR-ART-DISCLOSED:

U.S. PATENT DOCUMENTS

PAT-NO	ISSUE-DATE	PATENTEE-NAME	US-CL
<u>2847190</u>	August 1958	Slattery et al.	
<u>3010288</u>	November 1961	Jacobs	
<u>3023589</u>	March 1962	Jacobs	
<u>3307366</u>	March 1967	Smith	
<u>3309887</u>	March 1967	Jacobus	
<u>3309888</u>	March 1967	Jacobs	
<u>3335576</u>	August 1967	Philips	
<u>3495416</u>	February 1970	Morrissey, Jr. et al.	
<u>3802212</u>	April 1974	Martin et al.	
<u>3861165</u>	January 1975	Hirano	62/283
<u>3861167</u>	January 1975	Nijo	
<u>4045972</u>	September 1977	Tyree, Jr.	62/156
<u>4100759</u>	July 1978	Tyree, Jr.	
<u>4186562</u>	February 1980	Tyree, Jr.	62/62
<u>4271899</u>	June 1981	Noland	
<u>4498306</u>	February 1985	Tyree, Jr.	62/119
<u>5069039</u>	December 1991	Martin	
<u>5090209</u>	February 1992	Martin	62/50.3
<u>5199275</u>	April 1993	Martin	
<u>5313787</u>	May 1994	Martin	
<u>5396777</u>	March 1995	Martin	

#### OTHER PUBLICATIONS

Refrigerated Containerized Transport for "Jumbo" Jets, L. Tyree, Jr., 1971, pp. 521-525.

The Refrigerant Delemma, Kira Gould, Fleet Owner, Sep. 1989, pp. 94-100.

Cryogenic Refrigeration: Wave of the Future?, Ken Stadden, Heavy Duty Trucking, Jul. 1990, p. 128.

ART-UNIT: 344

PRIMARY-EXAMINER: Tanner; Harry B.

ATTY-AGENT-FIRM: Crutsinger & Booth

#### ABSTRACT:

A method and apparatus to refrigerate air in a compartment wherein liquid CO<sub>2</sub> is delivered through a first primary heat exchanger such that sufficient heat is absorbed to evaporate the liquid carbon dioxide to form pressurized vapor. The pressurized vapor is heated in a gas fired heater to prevent solidification of the pressurized carbon dioxide when it is depressurized to provide isentropic expansion of the vapor through pneumatically driven fan motors into a secondary heat exchanger. Orifices in inlets to the fan motors and solenoid valves in flow lines to the fan motors keep the vapor pressurized while the heater supplies sufficient heat to prevent solidification when the CO<sub>2</sub> vapor expands through the motors. CO<sub>2</sub> vapor is routed from the second heat exchanger to chill surfaces in a dehumidifier to condense moisture from a stream of air before it flows to the heat exchangers.

12 Claims, 8 Drawing figures

Full	Title	Citation	Front	Review	Classification	Date	Reference	Sequences	Attachments
Drawn Desc	Image								

KM/C

9. Document ID: US 5551972 A

US-PAT-NO: 5551972  
DOCUMENT-IDENTIFIER: US 5551972 A

TITLE: Absorption process without external solvent

DATE-ISSUED: September 3, 1996

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Wood; Glenn C.	Houston	TX		
Mehra; Yuv R.	The Woodlands	TX		

ASSIGNEE-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY	TYPE	CODE
Advanced Extraction Technologies, Inc.	Houston	TX			02	

APPL-NO: 08/ 518145 [PALM]  
DATE FILED: August 23, 1995

PARENT-CASE:

This application is a divisional of application Ser. No. 08/206,420 filed Mar. 4, 1994, issued as U.S. Pat. No. 5,462,583.

INT-CL: [06] B01 D 47/14

US-CL-ISSUED: 95/192; 95/96, 95/143, 95/208, 95/230, 95/237, 585/809  
US-CL-CURRENT: 95/192; 585/809, 95/143, 95/208, 95/230, 95/237, 95/96

FIELD-OF-SEARCH: 95/96, 95/187, 95/192, 95/141, 95/208, 95/127-130, 95/143-147, 95/230-232, 95/237-240, 62/17, 62/20, 585/809, 585/867, 208/101, 208/341, 55/227, 55/228

PRIOR-ART-DISCLOSED:

U.S. PATENT DOCUMENTS

PAT-NO	ISSUE-DATE	PATENTEE-NAME	US-CL
<u>3633371</u>	January 1972	Davison	62/17
<u>4035167</u>	July 1977	Starks	95/173
<u>4072604</u>	February 1978	Ward	208/341
<u>4333819</u>	June 1982	Scheifele Jr.	208/101
<u>4368058</u>	January 1983	Crowley et al.	55/227 X
<u>4421535</u>	December 1983	Mehra	62/17
<u>4494967</u>	January 1985	Barth	55/228 X
<u>4526594</u>	July 1985	Mehra	62/17
<u>4578094</u>	March 1986	Mehra	62/17
<u>4617038</u>	October 1986	Mehra	62/17
<u>4623371</u>	November 1986	Mehra	62/17
<u>4680042</u>	July 1987	Mehra	62/17
<u>4692179</u>	September 1987	Mehra	62/17
<u>4695672</u>	September 1987	Bunting	585/867
<u>4696688</u>	September 1987	Mehra	62/17
<u>4740222</u>	April 1988	Mehra	62/17
<u>4743282</u>	May 1988	Mehra	62/17
<u>4832718</u>	May 1989	Mehra	62/17
<u>4883514</u>	November 1989	Mehra	62/17
<u>4883515</u>	November 1989	Mehra et al.	62/17
<u>5220097</u>	June 1993	Lam et al.	585/809
<u>5224350</u>	July 1993	Mehra	62/20 X
<u>5321952</u>	June 1994	Forte	62/17
<u>5326929</u>	July 1994	Mehra et al.	62/17 X
<u>5462583</u>	October 1995	Wood et al.	95/192

#### FOREIGN PATENT DOCUMENTS

FOREIGN-PAT-NO	PUBN-DATE	COUNTRY	US-CL
3031727	April 1982	DE	
3132292	March 1983	DE	

#### OTHER PUBLICATIONS

Szatny et al., "Reporting Performance of a Field Test of The Mehra Process Nitrogen Rejection Unit, " Gas Research Institute, Topical Report (Nov. 1993), Houston, Texas, pp. 1-17.

"Mehra vs. Cold-Box: The Final Chapter, " Gas Processors Report (Sep. 6, 1993), Houston Texas.

"Cold-Box Answers Back, "Gas Processors Report (Jul. 12, 1993), Houston, Texas.

"Mehra Plant Beats Computer, "Gas processors Report (Jun. 14, 1993), Houston, Texas.

Mehra et al., "Noncryogenic N.sub.2 -rejection process gets Hugoton field test, "Oil & Gas Journal (May 24, 1993), pp. 62-71.

Mehra et al., "Non-Cryogenic Absorption-Based Mehra Process Technology Upgrades Hugoton Gases, "Advances in Nitrogen Rejection Tech. Sym., AIChE '93 Spring Nat'l Mtg. (Mar. 29, 1993), Houston, Texas, pp. 1-15.

Yuv R. Mehra, "Can We Really Afford to Keep Burning Light Olefins and Hydrogen in our Refineries?,"CMAI Seminar, Houston, Texas (Mar. 24-25, 1993), pp. 1-10.

"Nitrogen Rejection Made Easy," Gas Processors Report (Dec. 7, 1992), Houston, Texas.

Yuv R. Mehra, "Using Non-Cryogenic Absorption to Reject Nitrogen From Subquality Natural Gases, "Gas Separation International (Apr. 22-24, 1991), Austin, Texas, pp. 1-13.

James J. L. Ma, "Comparison of the Mehra Process for Nitrogen Rejection to a Cryogenic Process for Nitrogen Rejection from Subquality Natural Gas," Topical Report (Mar. 1991).

Pruitt et al., "Wyoming's Shute Creek plant uses NRU . . . , " Oil & Gas Journal

(Oct. 9, 1989) Technology, pp. 78-80.  
Yuv R. Mehra, "Recover and Purify Hydrogen Economically," NPRA Annual Meeting (Mar. 29-31, 1987), San Antonio, Texas.  
Yuv R. Mehra, "Process Flexibility Improves Gas Processing Margins", 66th Annual GPA Convention (Mar. 16-18, 1987), Denver, Co.  
Yuv R. Mehra, "Processing Hydrocarbon Gases with the Mehra Process Technology," Chemical Engineering (Oct. 27, 1986), Houston, Texas.  
Fair et al., "Ethylene purification -demethanization, " Chemical Eng. Progress, vol. 54, NO. 12, (Dec. 1958), pp. 39-47.

ART-UNIT: 135

PRIMARY-EXAMINER: Chiesa; Richard L.

ATTY-AGENT-FIRM: Arnold, White & Durkee

ABSTRACT:

An absorption process for separating a feed gas stream having components with a spectrum of volatilities including volatile (light) components, intermediate volatility components, and least volatile (heavy) components. The disclosed process includes the steps of: (1) contacting the feed gas stream with an internally generated liquid lean solvent stream in an absorber to produce a light product gas stream that is composed of predominantly light components and a rich solvent stream containing most of the intermediate and heavy components; (2) flashing the rich solvent stream at reduced pressure in a flash zone to produce an intermediate product gas stream composed predominantly of intermediate components and a lean solvent stream; (3) conveying the lean solvent stream from the flashing zone to the absorber, wherein the lean solvent is composed predominantly of heavy components supplied from the feed; the process does not use an external lean solvent. The process is particularly useful for rejecting nitrogen from natural gas and for recovering hydrogen from refinery and petrochemical process offgases.

14 Claims, 3 Drawing figures

Full	Title	Citation	Front	Review	Classification	Date	Reference	Sequences	Attachments	KMC
Drawn Desc	Image									

---

10. Document ID: US 5462583 A

L18: Entry 10 of 23

File: USPT

Oct 31, 1995

US-PAT-NO: 5462583

DOCUMENT-IDENTIFIER: US 5462583 A

**\*\* See image for Certificate of Correction \*\***

TITLE: Absorption process without external solvent

DATE-ISSUED: October 31, 1995

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Wood; Glenn C.	Houston	TX		
Mehra; Yuv R.	The Woodlands	TX		

ASSIGNEE-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY	TYPE	CODE
Advanced Extraction Technologies, Inc.	Houston	TX				02

APPL-NO: 08/ 206420 [PALM]

DATE FILED: March 4, 1994

US-CL-ISSUED: 95/192, 62/20, 95/96, 95/143, 95/208, 95/230, 95/237, 585/809  
 US-CL-CURRENT: 95/192, 585/809, 62/634, 62/938, 95/143, 95/208, 95/230, 95/237,  
 95/96

FIELD-OF-SEARCH: 95/187, 95/192, 95/208, 95/141, 95/127-130, 95/143-147, 95/230-232,  
 95/237-240, 95/96, 62/17, 62/20, 585/809, 585/867

PRIOR-ART-DISCLOSED:

U.S. PATENT DOCUMENTS

PAT-NO	ISSUE-DATE	PATENTEE-NAME	US-CL
<u>3633371</u>	January 1972	Davison	62/17
<u>4035167</u>	July 1977	Starks	95/173
<u>4421535</u>	December 1983	Mehra	62/17
<u>4526594</u>	July 1985	Mehra	62/17
<u>4578094</u>	March 1986	Mehra	62/17
<u>4617038</u>	October 1986	Mehra	62/17
<u>4623371</u>	November 1986	Mehra	62/17
<u>4680042</u>	July 1987	Mehra	62/17
<u>4692179</u>	September 1987	Mehra	62/17
<u>4695672</u>	September 1987	Bunting	585/867
<u>4696688</u>	September 1987	Mehra	62/17
<u>4740222</u>	April 1988	Mehra	62/17
<u>4743282</u>	May 1988	Mehra	62/17
<u>4832718</u>	May 1989	Mehra	62/17
<u>4883514</u>	November 1989	Mehra	62/17
<u>4883515</u>	November 1989	Mehra et al.	62/17
<u>5220097</u>	June 1993	Lam et al.	585/809
<u>5224350</u>	July 1993	Mehra	62/20 X
<u>5326929</u>	July 1994	Mehra et al.	62/17 X

OTHER PUBLICATIONS

Szatny et al., "Reporting Performance of a Field Test of The Mehra Process Nitrogen Rejection Unit," Gas Research Institute, Topical Report (Nov. 1993), Houston, Tex., pp. 1-17.

"Mehra vs. Cold-Box: The Final Chapter," Gas Processors Report (Sep. 6, 1993), Houston, Tex.

"Cold-Box Answers Back," Gas Processors Report (Jul. 12, 1993), Houston, Tex.

"Mehra Plant Beats Computer", Gas Processors Report (Jun. 14, 1993), Houston, Tex.

Mehra et al., "Noncryogenic N<sub>sub</sub>2 -rejection process gets Hugoton field test," Oil & Gas Journal (May 24, 1993), pp. 62-71.

Mehra et al., "Non-Cryogenic Absorption-Based Mehra Process Technology Upgrades Hugoton Gases," Advances in Nitrogen Rejection Tech. Sym., AlChE '93 Spring Nat'l Mtg. (Mar. 29, 1993), Houston, Tex., pp. 1-15.

Yuv R. Mehra, "Can We Really Afford to Keep Burning Light Olefins and Hydrogen in our Refineries?," CMAI Seminar, Houston, Tex. (Mar. 24-25, 1993), pp. 1-10.

"Nitrogen Rejection Made Easy," Gas Processors Report (Dec. 7, 1992), Houston, Tex.

Yuv R. Mehra, "Using Non-Cryogenic Absorption to Reject Nitrogen From Subquality Natural Gases," Gas Separation International (Apr. 22-24, 1991), Austin, Tex., pp. 1-13.

James J. L. Ma, "Comparison of the Mehra Process for Nitrogen Rejection to a Cryogenic Process for Nitrogen Rejection from Subquality Natural Gas," Topical Report (Mar. 1991).

Pruitt et al., "Wyoming's Shute Creek plant uses NRU . . . , " Oil & Gas Journal (Oct. 9, 1989) Technology, pp. 78-82.

Yuv R. Mehra, "Recover and Purify Hydrogen Economically," NPRA Annual Meeting (Mar. 29-31, 1987), San Antonio, Tex.

Yuv R. Mehra, "Mehra Process Flexibility Improves Gas Processing Margins," 66th

Annual GPA Convention (Mar. 16-18, 1987), Denver, Colo.  
Yuv R. Mehra, "Processing Hydrocarbon Gases with the Mehra Process Technology,"  
Chemical Engineering (Oct. 27, 1986), Houston, Tex.  
Fair et al., "Ethylene purification--demethanization," Chemical Eng. Progress, vol.  
54, No. 12 (Dec. 1958), pp. 39-47.

ART-UNIT: 135

PRIMARY-EXAMINER: Chiesa, Richard L.

ATTY-AGENT-FIRM: Arnold, White & Durkee

ABSTRACT:

An absorption process for separating a feed gas stream having components with a spectrum of volatilities including volatile (light) components, intermediate volatility components, and least volatile (heavy) components. The disclosed process includes the steps of: (1) contacting the feed gas stream with a liquid lean solvent stream in an absorber to produce a light product gas stream that is composed of predominantly light components and a rich solvent stream containing most of the intermediate and heavy components; (2) flashing the rich solvent stream at reduced pressure in a flash zone to produce an intermediate product gas stream composed predominantly of intermediate components and a lean solvent stream; (3) conveying the lean solvent stream from the flashing zone to the absorber, wherein the lean solvent is composed predominantly of heavy components taken from the feed; the process does not use an external lean solvent. The process is particularly useful for rejecting nitrogen from natural gas and for recovering hydrogen from refinery and petrochemical process off-gases.

14 Claims, 3 Drawing figures

Full	Title	Citation	Front	Review	Classification	Date	Reference	Sequences	Attachments	KINIC

---

11. Document ID: US 5396777 A

L18: Entry 11 of 23

File: USPT

Mar 14, 1995

US-PAT-NO: 5396777

DOCUMENT-IDENTIFIER: US 5396777 A

\*\* See image for Certificate of Correction \*\*

TITLE: Defrost controller

DATE-ISSUED: March 14, 1995

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Martin, Patrick S.	Dallas	TX		

ASSIGNEE-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY	TYPE CODE
General Cryogenics Incorporated	Dallas	TX			02

APPL-NO: 08/ 165723 [PALM]

DATE FILED: December 13, 1993

PARENT-CASE:

CROSS REFERENCE TO RELATED APPLICATION This is a division of application Ser. No. 08/017,796, filed Feb. 12, 1993, U.S. Pat. No. 5,313,787, which was a division of U.S. Pat. No. 07/841,590, filed Feb. 25, 1992, which issued on Apr. 6, 1993, now U.S. Pat. No. 5,199,275, which application is a continuation-in-part of application

Ser. No. 07/651,206, filed Feb. 6, 1991, entitled "ENTHALPY CONTROL FOR CO.<sub>2</sub> sub.2 REFRIGERATION SYSTEM", U.S. Pat. No. 5,090,209, which is a continuation-in-part of application Ser. No. 07/591,386, filed Oct. 1, 1990, entitled "CARBON DIOXIDE REFRIGERATION SYSTEM", now U.S. Pat. No. 5,069,039, which issued Dec. 3, 1991.

INT-CL: [06] F25 D 21/06

US-CL-ISSUED: 62/156  
US-CL-CURRENT: 62/156

FIELD-OF-SEARCH: 62/156, 62/155, 62/151, 62/140, 62/276, 62/80, 62/81

PRIOR-ART-DISCLOSED:

U.S. PATENT DOCUMENTS

PAT-NO	ISSUE-DATE	PATENTEE-NAME	US-CL
<u>2847190</u>	August 1958	Slattery et al.	62/156 X
<u>3010288</u>	November 1961	Jacobs	62/156 X
<u>3023589</u>	March 1962	Jacobs	62/156
<u>3309887</u>	March 1967	Jacobus	62/156
<u>3309888</u>	March 1967	Jacobs	62/156
<u>3495416</u>	February 1970	Morrissey, Jr. et al.	62/156
<u>4045972</u>	September 1977	Tyree, Jr.	62/156

ART-UNIT: 344

PRIMARY-EXAMINER: Tanner, Harry B.

ATTY-AGENT-FIRM: Crutsinger & Booth

ABSTRACT:

A method and apparatus to refrigerate air in a compartment wherein liquid CO.<sub>2</sub> sub.2 is delivered through a first primary heat exchanger such that sufficient heat is absorbed to evaporate the liquid carbon dioxide to form pressurized vapor. The pressurized vapor is heated in a gas fired heater to prevent solidification of the pressurized carbon dioxide when it is depressurized to provide isentropic expansion of the vapor through pneumatically driven fan motors into a secondary heat exchanger. Orifices in inlets to the fan motors and solenoid valves in flow lines to the fan motors keep the vapor pressurized while the heater supplies sufficient heat to prevent solidification when the CO.<sub>2</sub> sub.2 vapor expands through the motors. CO.<sub>2</sub> sub.2 vapor is routed from the second heat exchanger to chill surfaces in a dehumidifier to condense moisture from a stream of air before it flows to the heat exchangers.

8 Claims, 8 Drawing figures

Full	Title	Citation	Front	Review	Classification	Date	Reference	Sequences	Attachments
Drawn Desc		Image							

KMC

---

12. Document ID: US 5363655 A

L18: Entry 12 of 23

File: USPT

Nov 15, 1994

US-PAT-NO: 5363655  
DOCUMENT-IDENTIFIER: US 5363655 A

TITLE: Method for liquefying natural gas

DATE-ISSUED: November 15, 1994

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Kikkawa; Yoshitsugi	Kanagawa			JP
Yamamoto; Osamu	Kanagawa			JP
Sakaguchi; Junichi	Kanagawa			JP
Nakamura; Moritaka	Kanagawa			JP

ASSIGNEE-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY	TYPE CODE
Chiyoda Corporation	Kanagawa			JP	03

APPL-NO: 08/ 028025 [PALM]

DATE FILED: March 8, 1993

FOREIGN-APPL-PRIORITY-DATA:

COUNTRY	APPL-NO	APPL-DATE
JP	4-335540	November 20, 1992

INT-CL: [05] F25J 1/00

US-CL-ISSUED: 62/9; 62/23, 62/39

US-CL-CURRENT: 62/613

FIELD-OF-SEARCH: 62/9, 62/23, 62/39

PRIOR-ART-DISCLOSED:

U.S. PATENT DOCUMENTS

PAT-NO	ISSUE-DATE	PATENTEE-NAME	US-CL
<u>4229195</u>	October 1980	Forg	62/23
<u>4256476</u>	March 1981	Van Baush	62/23
<u>4303427</u>	December 1981	Krieger	62/23
<u>4619679</u>	October 1986	DeLong	62/39

ART-UNIT: 344

PRIMARY-EXAMINER: Capossela; Ronald C.

ATTY-AGENT-FIRM: Skjerven, Morrill, MacPherson, Franklin & Friel

ABSTRACT:

Provided is a method for liquefying natural gas which can be readily adapted to LNG plants of all sizes without requiring expensive and special heat exchangers. The liquefaction of feed gas of natural gas and recycle natural gas is carried out with a single-component refrigerant or a mixed refrigerant in a high temperature stage, and with a substantially isentropic expansion in a low temperature stage, and a non-liquefied part of the recycle gas after the expansion step is pressurized with a compressor and recycled along with a recycle stream of non-liquefied part of the feed natural gas, the liquefied part by the refrigerant exchanging heat with the non-liquefied part stream produced from the substantially isentropic expansion, in a plate-fin heat exchanger or the like. The compressor is driven by the power obtained by the substantially isentropic expansion.

12 Claims, 12 Drawing figures

13. Document ID: US 5313787 A

L18: Entry 13 of 23

File: USPT

May 24, 1994

US-PAT-NO: 5313787

DOCUMENT-IDENTIFIER: US 5313787 A

\*\* See image for Certificate of Correction \*\*

TITLE: Refrigeration trailer

DATE-ISSUED: May 24, 1994

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Martin; Patrick S.	Dallas	TX		

ASSIGNEE-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY	TYPE CODE
General Cryogenics Incorporated	Dallas	TX			02

APPL-NO: 08/ 017796 [PALM]

DATE FILED: February 12, 1993

PARENT-CASE:

CROSS REFERENCE TO RELATED APPLICATION This is a division of application Ser. No. 07/841,590 filed Feb. 25, 1992, now U.S. Pat. No. 5,199,275 which is a continuation-in-part of application Ser. No. 07/651,206 filed Feb. 6, 1991, entitled "ENTHALPY CONTROL FOR CO.sub.2 REFRIGERATION SYSTEM" now U.S. Pat. No. 5,090,209, which is a continuation-in-part of application Ser. No. 07/591,386 filed Oct. 1, 1990 entitled "CARBON DIOXIDE REFRIGERATION SYSTEM", now U.S. Pat. No. 5,069,039 which issued Dec. 3, 1991.

INT-CL: [05] F25B 41/04

US-CL-ISSUED: 62/222; 62/50.3, 62/51.1, 62/50.4, 62/275

US-CL-CURRENT: 62/222; 62/275, 62/50.3, 62/50.4, 62/51.1

FIELD-OF-SEARCH: 62/50.1, 62/50.2, 62/50.3, 62/50.4, 62/50.7, 62/51.1, 62/52.1, 62/272, 62/151, 62/156, 62/275, 62/80, 62/82, 62/222, 62/224, 62/225, 62/217

PRIOR-ART-DISCLOSED:

U.S. PATENT DOCUMENTS

PAT-NO	ISSUE-DATE	PATENTEE-NAME	US-CL
<u>3307366</u>	March 1967	Smith	62/51.1 X
<u>3335576</u>	August 1967	Philips	62/156
<u>3802212</u>	April 1974	Martin et al.	62/52
<u>3861167</u>	January 1975	Nijo	62/156 X
<u>4045972</u>	September 1977	Tyree, Jr.	62/51.1 X
<u>4100759</u>	July 1978	Tyree, Jr.	62/165 X
<u>4186562</u>	February 1980	Tyree, Jr.	62/51.1 X
<u>4271899</u>	June 1981	Noland	62/156 X
<u>4498306</u>	February 1985	Tyree, Jr.	62/239 X
<u>5069039</u>	December 1991	Martin	62/50.3
<u>5090209</u>	February 1992	Martin	62/50.3

#### OTHER PUBLICATIONS

Refrigerated Containerized Transport for "Jumbo" Jets, L. Tyree, Jr., 1971, pp. 521-525.

The Refrigerant Dilemma, Kira Gould, Fleet Owner, Sep. 1989, pp. 94-100.

Cryogenic Refrigeration: Wave of the Future?, Ken Stadden, Heavy Duty Trucking, Jul. 1990, p. 128.

ART-UNIT: 344

PRIMARY-EXAMINER: Tanner; Harry B.

ATTY-AGENT-FIRM: Crutsinger & Booth

#### ABSTRACT:

A method and apparatus to refrigerate air in a compartment wherein liquid CO<sub>2</sub> is delivered through a first primary heat exchanger such that sufficient heat is absorbed to evaporate the liquid carbon dioxide to form pressurized vapor. The pressurized vapor is heated in a gas fired heater to prevent solidification of the pressurized carbon dioxide when it is depressurized to provide isentropic expansion of the vapor through pneumatically driven fan motors into a secondary heat exchanger. Orifices in inlets to the fan motors and solenoid valves in flow lines to the fan motors keep the vapor pressurized while the heater supplies sufficient heat to prevent solidification when the CO<sub>2</sub> vapor expands through the motors. CO<sub>2</sub> vapor is routed from the second heat exchanger to chill surfaces in a dehumidifier to condense moisture from a stream of air before it flows to the heat exchangers.

11 Claims, 8 Drawing figures

Full	Title	Citation	Front	Review	Classification	Date	Reference	Sequences	Attachments	KWIC
Draw Desc	Image									

---

#### 14. Document ID: US 5199275 A

L18: Entry 14 of 23

File: USPT

Apr 6, 1993

US-PAT-NO: 5199275

DOCUMENT-IDENTIFIER: US 5199275 A

TITLE: Refrigeration trailer

DATE-ISSUED: April 6, 1993

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Martin; Patrick S.	Dallas	TX		

ASSIGNEE-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY	TYPE CODE
General Cryogenics Incorporated	Dallas	TX			02

APPL-NO: 07/ 841590 [PALM]  
 DATE FILED: February 25, 1992

PARENT-CASE:

CROSS REFERENCE TO RELATED APPLICATION This application is a continuation-in-part of application Ser. No. 07/651,206 filed Feb. 6, 1991, entitled "ENTHALPY CONTROL FOR CO.<sub>2</sub> REFRIGERATION SYSTEM" now U.S. Pat. No. 5,090,209 which is a continuation-in-part of application Ser. No. 07/591,386 filed Oct. 1, 1990 entitled "CARBON DIOXIDE REFRIGERATION SYSTEM", now U.S. Pat. No. 5,069,039 which issued Dec. 3, 1991.

INT-CL: [05] F25D 21/06

US-CL-ISSUED: 62/275, 62/156, 62/50.3  
 US-CL-CURRENT: 62/275, 62/156, 62/50.3

FIELD-OF-SEARCH: 62/50.1, 62/50.2, 62/50.3, 62/50.4, 62/50.7, 62/51.1, 62/52.1, 62/140, 62/156, 62/272, 62/275, 62/276, 62/526, 62/80, 62/81, 62/239

PRIOR-ART-DISCLOSED:

U.S. PATENT DOCUMENTS

PAT-NO	ISSUE-DATE	PATENTEE-NAME	US-CL
<u>3307366</u>	March 1967	Smith	62/5
<u>3335576</u>	August 1967	Philips	62/156
<u>3802212</u>	April 1974	Martin et al.	62/52
<u>3861167</u>	January 1975	Nijo	62/209
<u>4045972</u>	September 1977	Tyree, Jr.	62/156
<u>4100759</u>	July 1978	Tyree, Jr.	62/55
<u>4186562</u>	February 1980	Tyree, Jr.	62/62
<u>4271899</u>	June 1981	Noland	165/29
<u>4498306</u>	February 1985	Tyree, Jr.	62/119
<u>5069039</u>	December 1991	Martin	62/50.3
<u>5090209</u>	February 1992	Martin	62/50.3

OTHER PUBLICATIONS

Refrigerated Containerized Transport for "Jumbo" Jets, L. Tyree, Jr., 1971, pp. 521-525.

The Refrigerant Dilemma, Kira Gould, Fleet Owner, Sep. 1989, pp. 94-100.

Cryogenic Refrigeration: Wave of the Future?, Ken Stadden, Heavy Duty Trucking, Jul. 1990, p. 128.

ART-UNIT: 344

PRIMARY-EXAMINER: Tanner; Harry B.

ATTY-AGENT-FIRM: Crutsinger & Booth

ABSTRACT:

A method and apparatus to refrigerate air in a compartment wherein liquid CO.<sub>2</sub> is delivered through a first primary heat exchanger such that sufficient heat is

absorbed to evaporate the liquid carbon dioxide to form pressurized vapor. The pressurized vapor is heated in a gas fired heater to prevent solidification of the pressurized carbon dioxide when it is depressurized to provide isentropic expansion of the vapor through pneumatically driven fan motors into a secondary heat exchanger. Orifices in inlets to the fan motors and solenoid valves in flow lines to the fan motors keep the vapor pressurized while the heater supplies sufficient heat to prevent solidification when the CO<sub>2</sub> vapor expands through the motors. CO<sub>2</sub> vapor is routed from the second heat exchanger to chill surfaces in a dehumidifier to condense moisture from a stream of air before it flows to the heat exchangers.

12 Claims, 8 Drawing figures

Full	Title	Citation	Front	Review	Classification	Date	Reference	Sequences	Attachments	KWIC
Draw Desc   Image										

15. Document ID: US 5069039 A

L18: Entry 15 of 23

File: USPT

Dec 3, 1991

US-PAT-NO: 5069039

DOCUMENT-IDENTIFIER: US 5069039 A

\*\* See image for Certificate of Correction \*\*

TITLE: Carbon dioxide refrigeration system

DATE-ISSUED: December 3, 1991

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Martin; Patrick S.	Dallas	TX		

ASSIGNEE-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY	TYPE CODE
General Cryogenics Incorporated	Dallas	TX			02

APPL-NO: 07/ 591386 [PALM]

DATE FILED: October 1, 1990

INT-CL: [05] F25D 21/06

US-CL-ISSUED: 62/50.3; 62/156, 62/272, 62/526

US-CL-CURRENT: 62/50.3; 62/156, 62/272, 62/526

FIELD-OF-SEARCH: 62/156, 62/50.1, 62/50.2, 62/50.3, 62/50.4, 62/50.7, 62/526, 62/275, 62/272

PRIOR-ART-DISCLOSED:

U.S. PATENT DOCUMENTS

PAT-NO	ISSUE-DATE	PATENTEE-NAME	US-CL
<u>3307366</u>	March 1967	Smith	62/50.1 X
<u>3335576</u>	August 1967	Phillips	62/156
<u>3802212</u>	April 1974	Martin et al.	62/52
<u>3861167</u>	January 1975	Nojo	62/156 X
<u>4045972</u>	September 1977	Tyree, Jr.	62/156
<u>4100759</u>	July 1978	Tyree, Jr.	62/165 X
<u>4186562</u>	February 1980	Tyree, Jr.	62/62
<u>4498306</u>	February 1985	Tyree, Jr.	62/119

#### OTHER PUBLICATIONS

Refrigerated Containerized Transport for "Jumbo" Jets, L. Tyree, Jr., 1971, pp. 521-525.

The Refrigerant Dilemma, Kira Gould, Fleet Owner, Sep. 1989, pp. 94-100.

Cryogenic Refrigeration: Wave of the Future?, Ken Stadden, Heavy Duty Trucking, Jul. 1990, p. 128.

ART-UNIT: 344

PRIMARY-EXAMINER: Tanner; Harry B.

ATTY-AGENT-FIRM: Crutsinger & Booth

#### ABSTRACT:

A method and apparatus to refrigerate air in a compartment wherein liquid dioxide is delivered through a first primary heat exchanger such that sufficient heat is absorbed to evaporate the liquid carbon dioxide to form pressurized vapor. The pressurized vapor is heated in an external heat exchanger to prevent solidification of the pressurized carbon dioxide when it is depressurized to provide isentropic expansion of the vapor into a secondary heat exchanger. Pneumatically driven motors are driven by the pressurized carbon dioxide vapor to move air across the heat exchangers. Orifices in inlets to the motors and solenoid valves in flow lines to the motors keep the vapor pressurized while the external heat exchanger supplies sufficient heat to prevent solidification when it expands through the motors.

16 Claims, 2 Drawing figures

Full	Title	Citation	Front	Review	Classification	Date	Reference	Sequences	Attachments	KWIC
Drawn Desc	Image									

#### 16. Document ID: US 5036671 A

L18: Entry 16 of 23

File: USPT

Aug 6, 1991

US-PAT-NO: 5036671

DOCUMENT-IDENTIFIER: US 5036671 A

TITLE: Method of liquefying natural gas

DATE-ISSUED: August 6, 1991

#### INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Nelson; Warren L.	Orinda	CA		
Garcia; Luc	San Francisco	CA		

#### ASSIGNEE-INFORMATION:

NAME CITY STATE ZIP CODE COUNTRY TYPE CODE  
Liquid Air Engineering Company Montreal CA 03

APPL-NO: 07/ 475908 [PALM]  
DATE FILED: February 6, 1990

INT-CL: [05] F25J 3/06

US-CL-ISSUED: 62/23; 62/48.2  
US-CL-CURRENT: 62/612; 62/48.2

FIELD-OF-SEARCH: 62/11, 62/38, 62/39, 62/23, 62/48.2

PRIOR-ART-DISCLOSED:

U.S. PATENT DOCUMENTS

PAT-NO	ISSUE-DATE	PATENTEE-NAME	US-CL
<u>3616652</u>	November 1971	Engel	62/11
<u>4638639</u>	January 1987	Marshall et al.	62/38
<u>4740223</u>	April 1988	Gates	62/38
<u>4758257</u>	July 1988	Gates	62/38

ART-UNIT: 344

PRIMARY-EXAMINER: Capossela, Ronald C.

ATTY-AGENT-FIRM: Oblon, Spivak, McClelland, Maier & Neustadt

ABSTRACT:

A method of producing a methane-rich liquid stream from a stream of natural gas predominantly consisting of methane and also containing nitrogen, entailing:

- (a) supplying said natural gas stream at a pressure above atmospheric pressure,
- (b) cooling and liquefying said natural gas stream using one or more refrigeration cycles, and
- (c) expanding said liquefied natural gas to lower pressure in two or more stages in series, phase separating the gas and liquid phases produced during the expansion, thereby concentrating the nitrogen into the vapor phase, and producing a methane-rich liquefied natural gas.

25 Claims, 1 Drawing figures

[Full](#) | [Title](#) | [Citation](#) | [Front](#) | [Review](#) | [Classification](#) | [Date](#) | [Reference](#) | [Sequences](#) | [Attachments](#) | [KMC](#) |  
[Draw Desc](#) | [Image](#) |

---

17. Document ID: US 4846862 A

L18: Entry 17 of 23

File: USPT

Jul 11, 1989

US-PAT-NO: 4846862

DOCUMENT-IDENTIFIER: US 4846862 A

TITLE: Reliquefaction of boil-off from liquefied natural gas

DATE-ISSUED: July 11, 1989

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Cook, Philip J.	Schnecksville	PA		

ASSIGNEE-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY	TYPE CODE
Air Products and Chemicals, Inc.	Allentown	PA			02

APPL-NO: 07/ 241158 [PALM]  
DATE FILED: September 6, 1988

INT-CL: [04] F25J 1/00

US-CL-ISSUED: 62/9, 62/51.1, 62/54.1  
US-CL-CURRENT: 62/48.2, 62/51.1, 62/54.1

FIELD-OF-SEARCH: 62/54, 62/514R, 62/9

PRIOR-ART-DISCLOSED:

U.S. PATENT DOCUMENTS

PAT-NO	ISSUE-DATE	PATENTEE-NAME	US-CL
<u>3347055</u>	October 1967	Blanchard et al.	62/54
<u>3780534</u>	December 1973	Lofredo et al.	62/54
<u>3857245</u>	December 1974	Jones	62/54
<u>3857251</u>	December 1974	Alleaume	62/54
<u>3874185</u>	April 1975	Etzbach	62/54
<u>3889485</u>	June 1975	Swearingen	62/54
<u>3919852</u>	November 1975	Jones	62/54
<u>4188793</u>	February 1980	Watson et al.	62/54
<u>4543794</u>	October 1985	Matsutani et al.	62/54
<u>4766741</u>	August 1988	Bartlett et al.	62/54

ART-UNIT: 344

PRIMARY-EXAMINER: Capossela, Ronald C.

ATTY-AGENT-FIRM: Brewer, Russell L. Simmons, James C. Marsh, William F.

ABSTRACT:

The present invention relates to an improved process for the reliquefaction of boil-off gas containing up to 10% nitrogen resulting from the evaporation of liquefied natural gas (LNG) contained in a storage vessel. In the process, a closed-loop refrigeration cycle is utilized wherein an isenthalpically expanded stream is warmed against an initially cooled boil-off stream. The boil-off LNG stream is initially cooled by indirect heat exchange with an isentropically expanded refrigerant stream.

13 Claims, 3 Drawing figures

Full	Title	Citation	Front	Review	Classification	Date	Reference	Sequences	Attachments	KWIC
Drawn Desc	Image									

18. Document ID: US 4843829 A

L18: Entry 18 of 23

File: USPT

Jul 4, 1989

US-PAT-NO: 4843829

DOCUMENT-IDENTIFIER: US 4843829 A

TITLE: Reliquefaction of boil-off from liquefied natural gas

DATE-ISSUED: July 4, 1989

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Stuber, Wayne G.	Whitehall	PA		
Kovak, Kenneth W.	Macungie	PA		

ASSIGNEE-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY	TYPE CODE
Air Products and Chemicals, Inc.	Allentown	PA			02

APPL-NO: 07/ 266729 [PALM]

DATE FILED: November 3, 1988

INT-CL: [04] F17C 13/00

US-CL-ISSUED: 62/54.2; 62/51.1

US-CL-CURRENT: 62/54.2; 62/51.1

FIELD-OF-SEARCH: 62/54, 62/514R

PRIOR-ART-DISCLOSED:

U.S. PATENT DOCUMENTS

PAT-NO	ISSUE-DATE	PATENTEE-NAME	US-CL
<u>3874185</u>	April 1975	Etzbach	62/40
<u>3889485</u>	June 1975	Swearingen	62/54
<u>3967938</u>	July 1976	Daeschler et al.	62/54
<u>3970441</u>	July 1976	Etzbach et al.	62/54
<u>4055961</u>	November 1977	Admiral	62/54
<u>4267701</u>	May 1981	Toscano	62/514R
<u>4437312</u>	March 1984	Newton et al.	62/514R
<u>4766741</u>	August 1988	Bartlett et al.	62/54

ART-UNIT: 344

PRIMARY-EXAMINER: Capossela, Ronald C.

ATTY-AGENT-FIRM: Brewer, Russell L. Simmons, James C. Marsh, William F.

ABSTRACT:

The present invention relates to an improved process for the reliquefaction of boil-off gas containing up to 10% nitrogen resulting from the evaporation of liquefied natural gas (LNG) contained in a storage vessel. In the process, a closed-loop nitrogen refrigeration cycle is utilized wherein the nitrogen is isenthalpically expanded under conditions for generating a liquid and vapor with the liquid being pressurized by pumping and warmed against an initially cooled boil-off stream. The boil-off LNG stream is initially cooled by indirect heat exchange with

an isentropically expanded refrigerant stream.

7 Claims, 3 Drawing figures

Full	Title	Citation	Front	Review	Classification	Date	Reference	Sequences	Attachments
<a href="#">Draw Desc</a>   <a href="#">Image</a>									KM/C

19. Document ID: US 4522636 A

L18: Entry 19 of 23

File: USPT

Jun 11, 1985

US-PAT-NO: 4522636

DOCUMENT-IDENTIFIER: US 4522636 A

TITLE: Pipeline gas pressure reduction with refrigeration generation

DATE-ISSUED: June 11, 1985

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Markbreiter, Stephen J.	Edison	NJ		
Schorr, Hans P.	Douglaston	NY		

ASSIGNEE-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY	TYPE CODE
Kryos Energy Inc.	New York	NY			02
The Brooklyn Union Gas Company	Brooklyn	NY			02

APPL-NO: 06/ 578074 [PALM]

DATE FILED: February 8, 1984

INT-CL: [03] B01D 53/14

US-CL-ISSUED: 55/23; 55/32, 55/208, 62/87, 62/402

US-CL-CURRENT: 62/87; 62/402

FIELD-OF-SEARCH: 55/23, 55/29, 55/32, 55/171, 55/208, 62/115-117, 62/86, 62/87, 62/402, 62/88

PRIOR-ART-DISCLOSED:

U.S. PATENT DOCUMENTS

PAT-NO	ISSUE-DATE	PATENTEE-NAME	US-CL
<u>3002362</u>	October 1961	Morrison	62/87
<u>3355903</u>	December 1967	La Fleur	62/402
<u>3360944</u>	January 1968	Knapp et al.	62/12
<u>3735601</u>	May 1973	Stannard	62/87
<u>3886757</u>	June 1975	McClintock et al.	62/20
<u>4312851</u>	January 1982	Isalski et al.	55/23 X
<u>4420950</u>	December 1983	Bodas et al.	62/402

ART-UNIT: 135

PRIMARY-EXAMINER: Hart; Charles

## ABSTRACT:

The high pressure of pipeline gas is reduced to the low pressure of a distribution system with simultaneous generation of refrigeration by passing the gas through two successive centrifugal compressors driven by two turbo-expanders in which the compressed gas is expanded to successively lower pressures. Refrigeration is recovered from the gas as it leaves each turbo-expander. Methanol is injected into the pipeline gas before it is expanded to prevent ice formation. Aqueous methanol condensate separated from the expanded gas is distilled for the recovery and reuse of methanol.

12 Claims, 3 Drawing figures

Full	Title	Citation	Front	Review	Classification	Date	Reference	Sequences	Attachments	KWIC
Drawn Desc	Image									

20. Document ID: US 4329842 A

L18: Entry 20 of 23

File: USPT

May 18, 1982

US-PAT-NO: 4329842

DOCUMENT-IDENTIFIER: US 4329842 A

TITLE: Power conversion system utilizing reversible energy of liquefied natural gas

DATE-ISSUED: May 18, 1982

INVENTOR-INFORMATION:

NAME	CITY	STATE ZIP CODE COUNTRY
Hoskinson, deceased; Robert L.	late of Pacific Palisades	CA

ASSIGNEE-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY	TYPE CODE
Linhardt; Hans D.	Newport Beach	CA			04

APPL-NO: 06/ 165378 [PALM]

DATE FILED: July 2, 1980

INT-CL: [03] F02C 7/00, F17C 7/02

US-CL-ISSUED: 60/39.46G; 60/648, 60/727, 60/728, 62/52

US-CL-CURRENT: 60/39.465; 60/648, 60/727, 60/728, 62/50.2

FIELD-OF-SEARCH: 60/648, 60/726, 60/727, 60/728, 60/39.46R, 60/39.46G, 62/52

PRIOR-ART-DISCLOSED:

U.S. PATENT DOCUMENTS

PAT-NO	ISSUE-DATE	PATENTEE-NAME	US-CL
<u>3293850</u>	December 1966	Morrison	60/648
<u>3978663</u>	September 1976	Mandrin et al.	60/728
<u>3992891</u>	November 1976	Pocrnja	60/648 X

FOREIGN PATENT DOCUMENTS

FOREIGN-PAT-NO  
52-109782

PUBN-DATE  
March 1977

COUNTRY  
JP

US-CL

ART-UNIT: 341

PRIMARY-EXAMINER: Ostrager; Allen M.

ATTY-AGENT-FIRM: Jackson, Jones & Price

ABSTRACT:

A power conversion system comprising a combination of a liquefied natural gas vaporizing plant and a fuel burning power generating facility is disclosed. The liquefied natural gas vaporizing plant utilizes the cryogenic capacity of the liquefied natural gas to produce liquid air which is pumped to a high pressure by a liquid air pump. The liquid air is then brought into a heat exchanging relationship with air drawn into the vaporizing plant so that the high pressure liquid air is converted to high pressure gaseous air. The high pressure gaseous air which represents recovered reversible energy of the liquefied natural gas is fed into a combustion chamber of the fuel burning power generating plant. Since the power generating facility requires no significant output of power to drive a compressor to compress ambient air prior to its entry into the combustion chamber, the power generating facility is operated at a high efficiency.

23 Claims, 5 Drawing figures

Full	Title	Citation	Front	Review	Classification	Date	Reference	Sequences	Attachments	KWIC

---

21. Document ID: US 4158556 A

L18: Entry 21 of 23

File: USPT

Jun 19, 1979

US-PAT-NO: 4158556

DOCUMENT-IDENTIFIER: US 4158556 A

TITLE: Nitrogen-methane separation process and system

DATE-ISSUED: June 19, 1979

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Yearout; James D.	Hermosa Beach	CA	90254	

APPL-NO: 05/ 786130 [BALM]

DATE FILED: April 11, 1977

INT-CL: [02] F25J 3/02

US-CL-ISSUED: 62/28, 62/17, 62/39, 62/40, 62/31

US-CL-CURRENT: 62/622, 62/927

FIELD-OF-SEARCH: 62/23, 62/28, 62/27, 62/17, 62/38, 62/39, 62/31, 62/40

PRIOR-ART-DISCLOSED:

U.S. PATENT DOCUMENTS

PAT-NO	ISSUE-DATE	PATENTEE-NAME	US-CL
<u>1878123</u>	September 1932	Etienne	62/31
<u>2499043</u>	February 1950	Voorhees	62/39
<u>2534903</u>	December 1950	Etienne	62/39
<u>3074245</u>	January 1963	Becker	62/17
<u>3130026</u>	April 1964	Becker	62/17
<u>3516262</u>	June 1970	Bernstein	62/28

ART-UNIT: 177

PRIMARY-EXAMINER: Yudkoff; Norman

ATTY-AGENT-FIRM: Geldin; Max

ABSTRACT:

Method and system designed particularly for separating or removing nitrogen from mixtures of nitrogen and methane, particularly natural gas, over a wide range of nitrogen concentrations, employing low temperature rectification, for recovery of methane containing a substantially reduced amount of nitrogen, either as a gas or a liquid, including the features of regenerative heat exchange to cool the feed mixture to near its saturation point, prior to introduction into a fractionating column, by-passing a small stream of the feed around the regenerative heat exchanger as a means of controlling feed temperature and reboil heat in the column, passing the overhead nitrogen gas from the column in indirect heat exchange relation with the rectifying section of the column to generate reflux continuously along the separation zone, work expansion of the nitrogen waste stream to provide necessary refrigeration, providing downflow evaporation of the liquid product within the column in the case of gas producing plants, and sub-cooling the bottoms liquid product prior to evaporation of the product in the case of a gas producing plant, or prior to isentropic expansion to liquid storage in the case of a liquid producing plant.

20 Claims, 2 Drawing figures

Full	Title	Citation	Front	Review	Classification	Date	Reference	Sequences	Attachments	KWIC

22. Document ID: US 3735600 A

L18: Entry 22 of 23

File: USPT

May 29, 1973

US-PAT-NO: 3735600

DOCUMENT-IDENTIFIER: US 3735600 A

TITLE: APPARATUS AND PROCESS FOR LIQUEFACTION OF NATURAL GASES

DATE-ISSUED: May 29, 1973

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Dowdell; Stewart Harold	Oakmont	PA		
Pachaly; Robert W.	Greenwich	CT		

ASSIGNEE-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY	TYPE	CODE
Gulf Research & Development Company	Pittsburgh	PA			02	

APPL-NO: 05/ 036277  
DATE FILED: May 11, 1970

INT-CL: [] F25j 1/00, F25j 1/02, F25j 3/06

US-CL-ISSUED: 62/39; 62/9, 62/18, 62/26  
US-CL-CURRENT: 62/619

FIELD-OF-SEARCH: 62/9, 62/11, 62/23, 62/38, 62/39, 62/40, 62/54, 62/18, 62/26, 62/30, 62/18, 55/33, 55/62

PRIOR-ART-DISCLOSED:

U.S. PATENT DOCUMENTS

PAT-NO	ISSUE-DATE	PATENTEE-NAME	US-CL
<u>3312073</u>	April 1967	Jackson	62/9
<u>3358460</u>	December 1967	Smith	62/40
<u>3116135</u>	December 1963	Filstead	62/11
<u>2716332</u>	August 1955	Haynes	62/39
<u>2940268</u>	June 1960	Morrison	62/39
<u>3078634</u>	February 1963	Milton	55/62
<u>3087291</u>	April 1963	Jackson	55/62
<u>3109722</u>	November 1963	Dow	55/33
<u>3150942</u>	September 1964	Vasan	55/33
<u>2242299</u>	May 1941	Harrington	62/39
<u>2900796</u>	August 1959	Morrison	62/9

FOREIGN PATENT DOCUMENTS

FOREIGN-PAT-NO	PUBN-DATE	COUNTRY	US-CL
612,776	January 1961	CA	62/39

ART-UNIT: 175

PRIMARY-EXAMINER: Yudkoff; Norman

ASSISTANT-EXAMINER: Purcell; Arthur F.

ATTY-AGENT-FIRM: Neishloss; Meyer Keith; Deane E. Ryder; Thomas G.

ABSTRACT:

A process and apparatus for liquefaction of natural gas wherein the gas is cooled and liquified under pressure in a heat exchanger-liquifier. The pressurized cold liquid from the heat exchanger-liquifier is isenthalpically expanded to reduce the pressure and further cool the liquid while at the same time flashing a minor gas fraction. Refrigeration for the liquefaction of the natural gas is supplied by a circulating refrigerant stream which is compressed and work-expanded to obtain the necessary cooling. The minor flash gas portion of the liquefaction step is comingled with the circulating refrigerant stream so that the analysis of the refrigerant stream is always rich in the lighter portions of the liquefaction stream. This analysis difference aids in maintaining refrigeration temperature differentials to drive the liquefaction step. The work-expanded refrigerant portion undergoes a compression cycle and is work-expanded in an expansion turbine. The expansion turbine furnishes at least part of the power necessary to drive the compressor system in the refrigerant gas cycle.

13 Claims, 1 Drawing figures

23. Document ID: US 3724226 A

L18: Entry 23 of 23

File: USPT

Apr 3, 1973

US-PAT-NO: 3724226  
 DOCUMENT-IDENTIFIER: US 3724226 A

TITLE: LNG EXPANDER CYCLE PROCESS EMPLOYING INTEGRATED CRYOGENIC PURIFICATION

DATE-ISSUED: April 3, 1973

## INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Pachaly; Robert W.	Greenwich	CT		

## ASSIGNEE-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY	TYPE	CODE
Gulf Research & Development Company	Pittsburgh	PA			02	

APPL-NO: 05/ 135615 [PALM]  
 DATE FILED: April 20, 1971

INT-CL: [] F25j 1/00, F25j 3/00, F25j 3/02

US-CL-ISSUED: 62/39, 62/26, 62/20, 62/28, 62/40

US-CL-CURRENT: 62/613FIELD-OF-SEARCH: 62/23, 62/24, 62/27, 62/28, 62/26, 62/29, 62/38, 62/39, 62/40,  
 62/54, 62/52, 62/53, 62/30, 62/40

## PRIOR-ART-DISCLOSED:

## U.S. PATENT DOCUMENTS

PAT-NO	ISSUE-DATE	PATENTEE-NAME	US-CL
<u>3678435</u>	July 1972	Jackson	62/28
<u>3292381</u>	December 1966	Bludworth	62/27
<u>2600110</u>	June 1952	Hachmuth	62/26
<u>3348384</u>	October 1967	Harmens	62/38

ART-UNIT: 175

PRIMARY-EXAMINER: Yudkoff; Norman

ASSISTANT-EXAMINER: Purcell; Arthur F.

ATTY-AGENT-FIRM: Neishloss; Meyer Keith; Deane E. Ryder; Thomas G.

## ABSTRACT:

A process and apparatus for the liquefaction of natural gas wherein raw feedstock is cryogenically fractionated to remove essentially all of the carbon dioxide and C.<sub>sub.5</sub>.sub.+ hydrocarbons therefrom, and wherein the cryogenically purified feedstock is cooled and liquefied under pressure in a cryogenic heat exchanger. The pressurized cold liquid from the heat exchanger is isenthalpically expanded to

reduce the pressure and further cool the liquid while at the same time flashing a minor gas fraction. Refrigeration for the liquefaction of the natural gas is supplied by a circulating refrigerant stream which is compressed and work-expanded to obtain the necessary cooling. The minor flash gas portion of the liquefaction step is commingled with the circulating refrigerant stream so that the analysis of the refrigerant stream is always rich in the lighter portions of the liquefaction stream, thus aiding in maintaining refrigeration temperature differentials to drive the liquefaction step. The work-expanded refrigerant portion undergoes a compression cycle and is work-expanded in a series of expansion turbines. The expansion turbines furnish at least part of the power necessary to drive the compressor system in the refrigerant gas cycle.

17 Claims, 1 Drawing figures

Full	Title	Citation	Front	Review	Classification	Date	Reference	Sequences	Attachments
									KWIC

Draw Desc | Image |

KWIC

[Generate Collection](#)

[Print](#)

Term	Documents
ISENTROPIC\$4	0
ISENTROPIC	1294
ISENTROPICAL	2
ISENTROPICALLY	371
ISENTROPICITY	1
ISENTROPICS	3
(17 AND ISENTROPIC\$4).USPT,PGPB,JPAB,EPAB,DWPI.	23
(L17 AND ISENTROPIC\$4).USPT,PGPB,JPAB,EPAB,DWPI.	23

Display Format:  [Change Format](#)

[Previous Page](#)

[Next Page](#)



Creation date: 12-11-2003

Indexing Officer: BSEBHATU - BURUK SEBHATU

Team: OIPEBackFileIndexing

Dossier: 10051425

Legal Date: 07-29-2003

No.	Doccode	Number of pages
1	CTNF	6
2	892	1
3	1449	2

Total number of pages: 9

Remarks:

Order of re-scan issued on .....